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PROCEDURAL GUIDE
EARTH SCIENTIST PARTICIPATION IN TIMBER SALE PLANNING, HARVEST ACTIVITY, REGENERATION AND POST HARVEST ACTIVITY

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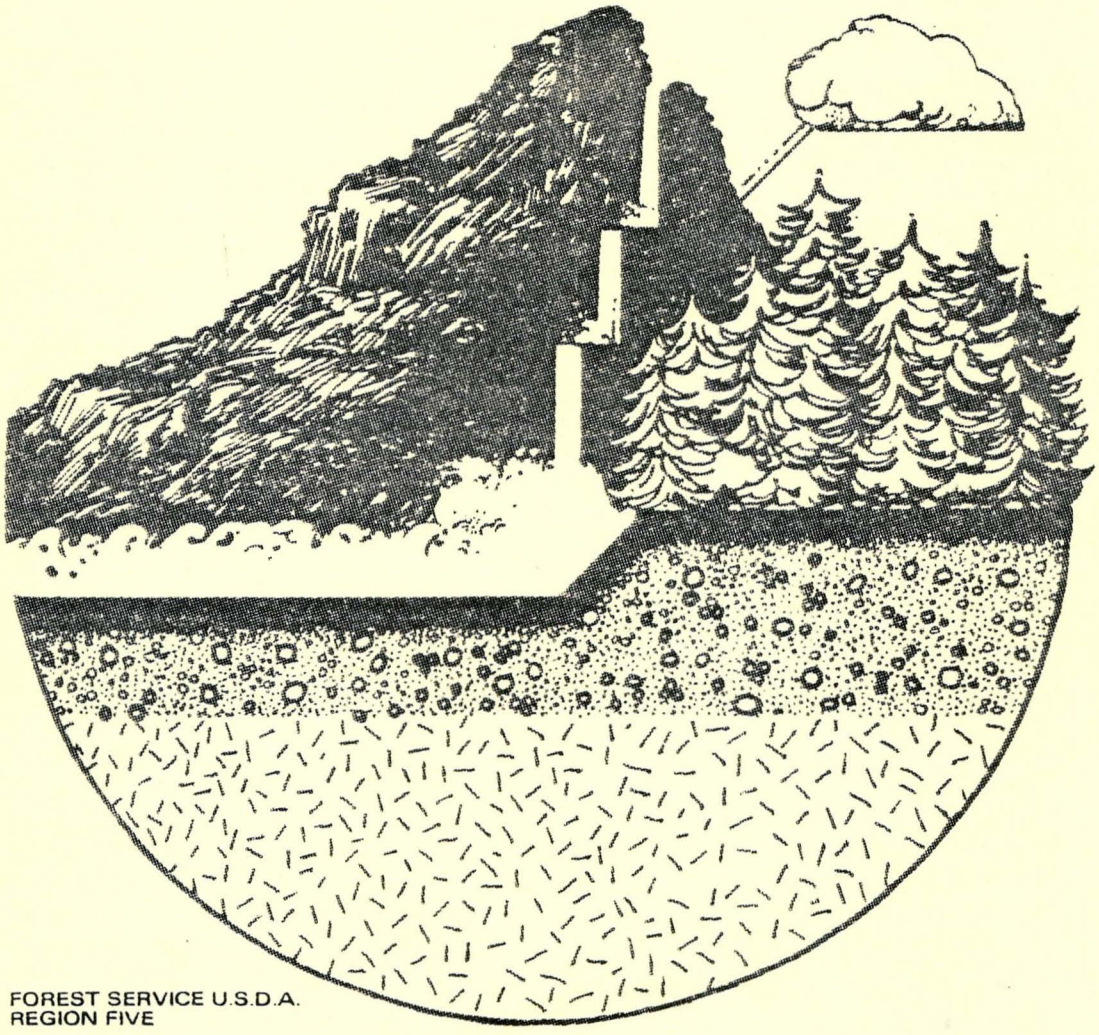

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PROCEDURAL GUIDE FOR EARTH SCIENTIST PARTICIPATION IN TIMBER SALE PLANNING, HARVEST ACTIVITY, REGENERATION, AND POST HARVEST ACTIVITY

SD390
P7

Composite of
Work Group Recommendations
at the
Earth Science Symposium II
(February 26 - March 2, 1979)

Compiled by Stanislaus NF

Pacific Southwest Region
Forest Service

April 1979

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I. INTRODUCTION

This is the first approximation of a procedural guide for Earth Scientist participation in the Timber Sale Planning Process (TSPP). Support services are needed for every phase of tree management, from conception of a harvest proposal to the completed reforestation program. The emphasis in this guide is on the interdisciplinary use of specialists to assess and evaluate proposed management decisions. However, each specialist must also function individually to collect and analyze data. The effectiveness of interaction between specialists will depend on how well each specialist has prepared his data.

This procedural guide is structured after the NEPA format, as described in FSM 1950, and NFMA, Section 219.9. Although the guidelines are neither precise nor comprehensive, they will provide an orderly, uniform approach to TSPP for every Earth Scientist in the Region. In the process of implementation there will be obvious changes that need to be made, and each forest can add procedures to accommodate their unique situation.

Several examples of Earth Scientist input to TSPP are provided in the appendix. These should be used as mind joggers. They must be added to and improved upon by each forest during the next two years.

The objectives of preparing this procedural guide are:

1. To identify the role of Earth Scientists in the decision making process as it relates to TSPP, harvest, regeneration, and stand improvement,

2. To standardize an orderly approach that can be followed by Earth Scientists in planning and implementing timber sales, and

3. To provide a baseline document that can be refined and improved on by R-5 Earth Scientists for 2 or more years, then revised at the Earth Science Symposium III.

Much of the content of this document is the result of Earth Science Symposium II, work group recommendations. At the symposium, six discussion groups, made up of over 40 participants, addressed the basic elements of this process in order to prepare these guidelines. The charter of the work groups was:

1. What is our present involvement in the NEPA decision making process?

2. What should we be involved in to do a better job?

3. How can we accomplish #2?

The participants in these discussion groups were interdisciplinary, although the majority were Earth Scientists. This procedural guide is therefore a product of skilled specialists, who are currently involved in the NEPA/TSPP program. This is considered a first approximation that will be revised. Individuals using these guidelines should record any changes needed, and submit them to the R.O. for inclusion in subsequent revisions.

Time sequences that are discussed assume that the TSPP is on schedule. Local adjustments will be needed during the "catch-up" period, to implement this procedural guide as fully as possible.

II. THE FOREST SERVICE DECISION MAKING PROCESS

A. The NEPA Process

Table 1 shows the role of participants for each of the NEPA steps. The decision making process is keyed to the ID Team involvement and interaction. The steps in table 1 are an expansion of the process given in FSM 1950, where one less step is described. A description of each of the steps is presented below. The work group output from the Earth Science Symposium II is incorporated into the discussion for each step.

Table 1. Role of Participants in the Forest Service NEPA Process

THE NEPA PROCESS	LINE OFFICER	INTERDISCI-PLINARY TEAM	AGENCIES, ORGANIZATIONS, & INDIVIDUALS
1. Environmental anaylsis and decision process:			
A. Identification of issues, concerns, & opportunities	Responsible	Recommend	Recommend
B. Development of evaluation criteria	Responsible	Recommend	Recommend
C. Data and information collection	Review	Responsible	Provide information
D. Situation assessment	Review	Responsible	Provide information
E. Formulation of alternatives	Responsible	Assist	Recommend
F. Estimate the effects of alternatives	Review	Responsible	Provide information
G. Evaluation of alternatives against the criteria	Responsible	Assist	Provide information
H. Selection of the alternative	Responsible	Recommend	Recommend
2. Documentation of alternative selection process	Review	Responsible	Review
3. Establish decision date	Responsible	Recommend	Review
4. Monitoring and evaluation of the decision	Responsible	Assist	Assist

Description of each step in the NEPA process

Step 1A. IDENTIFICATION OF ISSUES, CONCERNS, AND OPPORTUNITIES

The identification of issues, concerns, and opportunities (I, C, & O), and the need to make a decision, is the first step in the process. At this point the possible conflicts or impacts of timber harvest on the other natural resources are identified. This includes opportunities to improve both the timber resource, and all other resources as well.

The Letter of Management Intent (LMI) begins the process. Each Ranger District prepares one for each sale and each specialist must respond with the requested information. There may be an ID Team meeting before the position statement to formulate the basic alternatives and concerns.

One way to simplify this step is to compile a check list of I, C, & O that apply to the Forest. This would be a starting point, not an end product.

When the needs exceed available specialist time, document what can and cannot be done with the available time in this phase of the NEPA process. This is for the use of the Line Officer and the ID Team leader. They may want to contract, adjust the specialist time schedule, or accept a lesser quality product.

Step 1B. DEVELOPMENT OF EVALUATION CRITERIA

Evaluation criteria are defined to guide the subsequent steps of the decision making process. These criteria are frequently and repeatedly used in NEPA Steps 1C, 1D, 1E, 1F, 1G, and 4. Criteria must always be developed for NEPA Step 1G, in order to have a base for evaluation.

An example of evaluation criteria for Step 1G could be: "Each department, agency...of the Federal Government...shall comply with Federal, State, interstate, and local requirements respecting control and abatement of pollution..." (Clean Water Act, P.L. 92-500, Sec. 313).

In order to meet resource objectives, we need to develop standard criteria to assess project effects. The criteria must be measurable, practical, and relevant to the proposed project. If there are standards that must be met, they are documented at this step. These come from Laws, Policy Statements, Manuals, Forest Standards, etc., and can include water quality, timber cut levels, productivity levels, restocking standards, VQO's, and others.

The evaluation criteria may be drawn from the critical issues, concerns, and opportunities developed in Step 1A.

When a critical issue or concern is identified, then the evaluation criteria should also be presented by which we can measure or assess the concern. The Line Officer is responsible for this step.

Step 1C. DATA AND INFORMATION COLLECTION

The inventory of data and information needed for making evaluations leading to a decision is all that is necessary. The level of intensity of data to be collected is determined during NEPA Step 1B, and must be tied to the critical issues, evaluation criteria, and the questions that need to be answered. The intensity and level are mutually agreed upon by both the Line Officer and the specialist. The data is used to address the I, C, & O, identified in NEPA Step 1A.

Timing of data gathering, by discipline, must be carefully thought out. The most critical data should be addressed initially, such as the visual resource constraint that might limit other resource activity. The job of data gathering should not proceed without a working knowledge of the I, C, & O, and the evaluation criteria. In "crash" situations, the type and intensity of inventory must be clearly defined in terms of time and funds. Timing is also important on most Forests because of the limited work season due to snow.

The ID Team is responsible to provide the data on time and in a professional display that is understandable to the other team members. It will not be possible, in most cases, to interact with the other team members until field data has been collected and analyzed.

Step 1D. SITUATION ASSESSMENT

The collected information in NEPA Step 1C allows for the next step, an analysis of the capability and suitability of the area for timber resource management. This includes an assessment of the capability of the area to supply goods and services other than wood products. This step also includes consideration of "special conditions or situations which involve hazards that may cause irreversible damages" (NFMA).

The data must be interpreted to meet the needs of the evaluation criteria developed for each specific project, in NEPA Step 1B. The analysis of data phase requires that the ID Team and the Line Officer meet to consider if any changes in I, C, & O are needed. It also requires a review of the NEPA steps up to now to determine what the environmental assessment process has surfaced.

The ID Team meeting may change the direction for data to be collected, or change the type of data being collected. It is the responsibility of the ID Team to accurately and reliably analyze and interpret the data that they have collected, and to make sure that the team members all understand the importance of the interpretation. The Line Officer may also decide that enough data has been collected, and proceed to the next NEPA step.

Step 1E. FORMULATION OF ALTERNATIVES

This step calls for the formulation of alternative actions to provide different ways to address major issues, concerns, and opportunities (NEPA Step 1A). The alternatives are designed to describe proposed actions for the "production of goods and services, and control and mitigation of adverse environmental effects" (NFMA). This includes such things as volumes of timber production as it relates to achieving water quality standards and VQO's, and describes tradeoffs that result.

This is the point in the NEPA process where Best Management Practices (BMP) are employed, or perhaps developed. They serve as a baseline of reasonable practices that can be used to achieve the objectives of each resource. It is not a requirement to develop BMP for each timber sale, but to use the ones that are already described and refine them as needed.

The ID Team should formulate the alternatives through interaction with the sale planners' first approximation of the timber prescription. Each ID Team member may suggest alternatives when they present their data to the team leader. If the evaluation criteria (NEPA Step 1B) are quantified, or use a numerical rating system to describe relative values, then each alternative can be assessed in quantitative terms.

The formulation of alternatives may require that additional data be collected or that any of the above steps be reassessed. For example, a new alternative may create the need for additional evaluation criteria, which will require more or different data and interpretation of the data.

Step 1F. ESTIMATE THE EFFECTS OF ALTERNATIVES

In this step the effects of implementing each alternative is estimated as it relates to the present situation. Effects are expressed in terms of future outputs, expenditures, costs, and changes in the physical, biological, economical and social components of the environment. The adverse effects that cannot be avoided and resource commitments that are irreversible and irretrievable will be included in the analysis of the effects of alternatives. The effects should be quantified, using available tools and the most accurate expression of quantities.

ID Team interaction is necessary for this step. The estimation of effects must be consistent with the agreements reached in NEPA Steps 1B and 1C. The forest specialists need to develop reliable systems to estimate the effects of alternatives that are consistent with research and other professional findings. This may be a simple table describing the various levels of quality that can be reached in each resource. Two examples are: the packet developed by Happy Camp Ranger District (Klamath NF), and the Stanislaus Channel criteria tables. The effects of alternatives are a mixture of known quantities, professional estimates, and relative values. In order to compile a reliable source of alternative effects, it will require follow-up and evaluation of these estimates to compare the actual effect to that which was predicted.

This is an absolute essential, and is most easily accomplished by the specialist and the Ranger District people who execute the prescription. If a treatment is not effective, or is over effective, then feedback should make it known. In the ID Team interaction process, the results of the past alternatives on past timber sales must be discussed.

Step 1G. EVALUATION OF ALTERNATIVES AGAINST THE CRITERIA

Note on Table 1 the roles of participants in this step. After a feasible range of alternatives has been formulated, their environmental, economic and social effects are evaluated against the criteria established in NEPA Step 1B. This evaluation is used to determine the rationale for choosing the preferred alternative.

Each alternative is evaluated and ranked against the evaluation criteria to display their relative merits. The ID Team assists the Line Officer in doing this job. One method is to use a matrix, but if this is used then it needs to be verbalized for the sake of whoever reviews the report. The rationale for each evaluation in the matrix may not be necessary, but the general thought process needs to be documented to indicate the things that were considered. The preferred alternative is the product of this step.

Step 1H. SELECTION OF THE ALTERNATIVE

After ID Team interaction, public involvement, publication, evaluation of further input, revision of alternatives as required, the appropriate Line Officer makes a decision to implement an action. The ID Team recommends the preferred alternative (FSM 1951.9) along with their rationale for the selection. The ID Team is also available to interact with the Line Officer and assist as needed.

The Line Officer may request further environmental analysis or additional information from the ID Team. Whether the preferred alternative or some other alternative is selected, the Line Officer must document the rationale for his decision.

Step 4. MONITORING AND EVALUATION OF THE DECISION

This step is designed to test the decision and the decision making process for the purposes of refinement and improvement in future decisions, and future environmental analysis processes. Evaluation must be made at regularly established intervals to determine how well the objectives and standards set forth in the decision are being met. The NFMA requires that "management activities associated with each of the resources shall be evaluated through monitoring on an appropriate sample basis." These evaluations serve as the basis for identifying needed changes in management direction as deemed necessary to meet goals and objectives on an environmentally sound basis (NFMA).

There are three types of monitoring that should occur:

Administrative Monitoring

1. This monitors the EA implementation. How well was the EA implemented? Seldom can an EA be implemented exactly as it is written. This included the 3 phases of timber harvest.
   a. Layout
   b. Harvest
   c. Post-Harvest
2. Administrative monitoring is done by Line Officers with the assistance of the ID Team, and other interested persons.
3. The purpose is to improve the quality of the next decision.

Technical Monitoring

1. This type monitors the actual effects of the selected alternative as compared to the predicted effects. Seldom are the actual effects exactly as predicted.
2. All of the NEPA steps are re-assessed.
   a. Were the issues, concerns, and opportunities valid?
   b. Were the evaluation criteria acceptable?
   c. What additional data should have been collected? What data was collected that was not needed?
   d. Etc., as much as is necessary.
3. Quantative measurements are necessary to test the effectiveness of mitigating procedures.

Long-Term Monitoring

1. This monitors the recovery of the resources (soils, reforestation, watershed stability, VQO's, et al) and ties back to NEPA Step 1A where the feedback information is used to assess the environmental impacts of the next entry.
2. The purpose is to assist both Line Officers and ID Teams.
3. Monitoring is done to the intensity necessary to address the next timber sale effects, and no more. Infinite research is usually not necessary, nor is it usable in the next decision.

The projects that are selected for monitoring should be programmed into the Program Development and Budgeting (PD&B) process, and perhaps indicated at the position statement stage. Pre-activity monitoring may sometimes be identified in the position statement. The use of "Level III timber inspections - Six Rivers NF," and documentation of "spontaneous" monitoring by specialists are two possible ways to accumulate a history of the active effects of an alternative.

B. The NEPA Process in Timber Sale Planning

Figure 1 displays the general relationship between these two processes. Note that the monitoring and evaluation process continues past the sale date and through all of the post-harvest activity to the next planning phase. A further display on how the two processes interact is provided in Matrix 1 and Matrix 2. These are not given as the only way, but simply illustrate one concept of the actions that can be taken in each of the NEPA steps.

C. How to Implement the NEPA/TSPP Process

The next concern is how these two processes can be implemented on an individual forest. There is no universal method that will fit all situations and circumstances. However, there are some common elements that must be dept in mind.

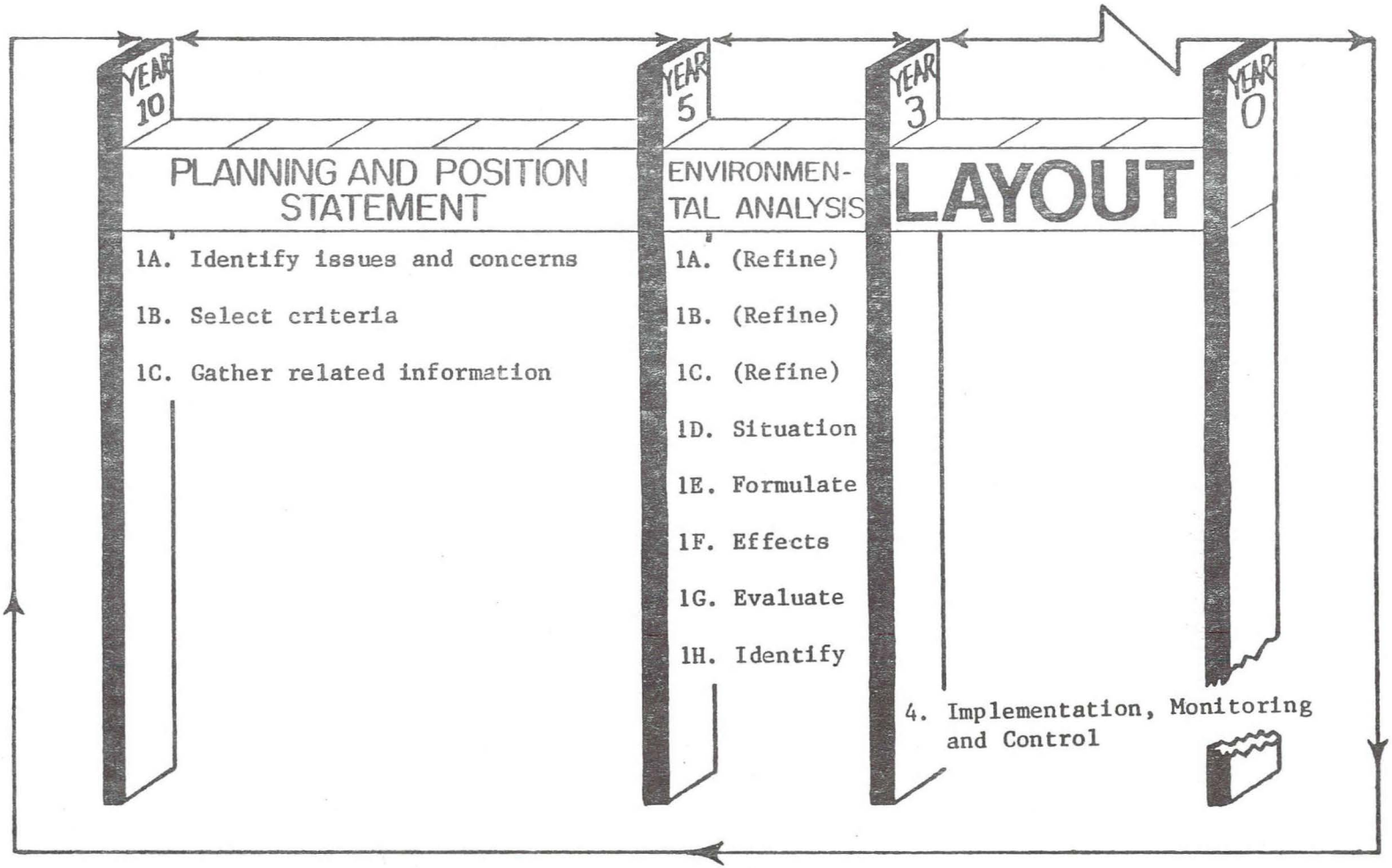
The use of the NEPA process is seldom done in a chronological, stepwise manner. Generally, the process flows from Step 1(A-H) to Step 4, but along the way:

1. Input for several steps is made out of sequence, as part of the process.
2. Revision of earlier steps is necessary as new ones are completed.
3. The process alternates back and forth between two or three steps in the ID Team interaction.

The following table illustrates the implementation process as it has actually been used for one timber sale. The sequence of action steps begins with the letter of management intent (LMI). When the specialist receives the LMI, several events begin to take place (see Table 2).

Figure 1.

THE NEPA PROCESS & THE TIMBER SALE PLANNING PROCESS



Matrix 1 - The NEPA Process in Timber Sale Planning

NEPA STEP:	TSPP: * LETTER OF INTENT * POSITION STATEMENT	* ENVIRONMENTAL * ANALYSIS PROCESS	*EA* *	* LAYOUT *	* LOGGING PHASE *	* CULTURAL PHASE *
1A ISSUES, CONCERNS, & OPPORTUNITIES	Policy; MU Mgmt; basic FS mssns, goals, objs--by functns. Evaluate public involvmt needed. Estab ID Team composition. Spec can suggest.	Re-eval, & estab new I, C,&O if needed. ID need to amend EA for post-harvst actvties. ID & address post-harvst I, C,&O, eg KV proj.		Eval new I,C,&O that surface during layout, as feedback to planners. Amend EA. ID Team review or amend w/ existg authority.	Amend EA in special situatns where orignl thinking does not fit. Involves feedback to sale planners and ID Team.	Amend EA to meet actual sale area condtns & documt changes from orignl plans. Modify SAI plans. This is place to be certain I,C,&O are identified & carried over to this phase.
1B EVALUATION CRITERIA	Objs for ea resource--quantify. Use std criteria, laws, policies. Rank relative importance of ea concern, or impact of criteria.	Estab post-harvst EC & new EC as needed. EC to be used to measure effects, & to evaluate alternatives for accomp.		ID any new evaluation criteria that might better be applied.	Red flags identified and documented.	Adjust existing EC & develop new ones to meet the actual conditions that were experienced.
1C INVENTORY	Existing data from data base; analyze need for more intensv inventory. Prioritz data collectn needs. Set time frames for MD & ID modes.	Collect new data needed to define situatn--only type & intensity relevnt to NEPA Steps 1A & 1B--as agreed to by line & core team ldrs; TIMING--col most critcl 1st. Do not proceed w/ inventory until Steps 1A & 1B are done. Devlp R-5 exampls.		Soil protectn measures need is inventoried; also need for more intense surveys, eg plantations.	No inventory.	Eval original inventory in view of actual events. What could have been done better? What did not need to be done? Do the EC fit this timber sale? Do the EC fit the post-harvest activity?
1D SITUATION ASSESSMENT	Interpret known data as well as present raw data. Address to I,C, &O.	Interpret data to meet needs of NEPA Stps 1A & 1B for proj. Did assessmt surface new I,C,&O? Notify core team leader of major constraints & conflicts.		Layout SPZ, plantatns, roads, & detail loggng prescrp. Detailed stand prescrp sale stumpage appraisal, specialist as needed to interpret EA.	Detailed prescrp for post-harvst site restoratn; on-the-grnd trng for TSA & specs. Compare actual to predicted. New EC for next entry.	Assess original analysis and interpretation of data. New I,C,&O may be identified. Feedback to line.
1E FORMULATE ALTERNATIVES	Tentative viable alt.	Test tentatv alt & dev new ones to meet NEPA Stp 1A reqmts. Include mitigat measures and/or mgmt requirements.		New alternative formulation for new I,C,&O or evaluation criteria that arises in layout.	No alt formulated.	Feedback on better alts for next entry. Formulate new alternatives for amendments.
1F ESTIMATE EFFECTS OF ALTERNATIVES	rough	Estimate effects of alts--express quantatvly, or a relatv value rating; keep consistent w/ NEPA Steps 1A & 1B.		Re-assess effects if needed due to changes in orig estimate as a result of actual layout.	Red flags ID & docmt. Compare actual w/ est w/ fdback to speclsts & ID Team. Adjust mgt reqmts for SAI plan.	Re-assess to compare actual events and responses to be estimated.
1G EVALUATE ALTERNATIVES		Eval and rank each alt against EC in NEPA Step 1B. ID need to re-formulate alt; recmd preferd alt w/ mgt rqmt respon.				Feedback on evaltn of alt. Compare selected w/ others considered as viable alts.
1H DECISIONS	Go or no go decision.	Selct alt w/ ID Team asst.		Contract.	SAI plan.	Amended EA.
4 MONITOR & EVALUATE THE DECISION, W/ FEEDBACK	Identify needs for, and estab baseline monitrg needs; proj to be monitored, per LMP.	ID needed eval & montr in mgmt rqmt sec of EA. Person responsbl/duratn of montrg must be consistent w/ NEPA Steps 1A,1B,&1C, but include Admin/Tech/Long-Term monitoring.		Monitor admin of EA implementatn. Level III inspections.	Montr SA. Participate in TSA cert teams.	Test effects of EA mitigatg measures, & mgt rqmts. Compare actual w/ est'd. Montr lng-trm resource recovery; spot chk & documt spontaneous monitoring in land data base. Assess need & intensity for future, & compare w/ predicted & actual events.

Matrix 2 - Earth Science Input to Timber Sale Planning, Harvest and Regeneration

TSPP: / NEPA:	LETTER OF MGMT INTENT POSITION STATEMENT	ENVIRONMENTAL ANALYSIS	LAYOUT	LOGGING PHASE	CULTURAL PHASE	INPUT TO NEXT ENTRY--PS & EA
ISSUES, CONCERNS, & OPPORTUNITIES Suggest degree of involvement in ID Teams.	All specialists must respond to letter of mgmt intent. Preliminary establishment of concerns, i.e., can soil and water be protected? are soils capable of regen? what soil or water restoration opportunities exist? are there unstable areas?	Re-eval & estab new concerns surfaced in intensive inventory. Estab SW&G opportunities, i.e., soil/stream restoration. Address post harvest S&W concerns. Set time schedules for specialists. ID Team participation. Refine this and NEPA step 1B during your inventory. Multi-disciplinary.	S&W interactn w/layout forester to implemnt EA. ID new I,C,&O. Accum info for chklst. Partcpate in markg trees in critcl areas: SPZ, wet meadow PZ, unstable soils. Consider correctns to EA that are needed.	Document issues, concerns, and opportunities during M&E.	Review & refine issues and concerns for data base.	Revised/new issues, concerns, and opportunities from monitoring and evaluations results.
EVALUATION CRITERIA	Establish and rank importance of concerns. Display known required S&W studies. Suggest criteria for estimating effects and evaluating alternatives. Display forest plan objectives for S&W. Establish S&W objectives for projects.	Re-eval rankg of importnce of SW&G I,C,& O. Finalize display of S&W qual standrds to be required. Estab criteria for estimated effects of alt., i.e., acceptable changes in EHR, W.Q., soil prod. Estab sys for eval'tng alts., i.e., ratng sys. Estab how meas'mts are expressed, i.e., sed. in T/mi^2, prod. in #/A, water yield in AF/A. ID Team participation.	Analyze actual layout in terms of developed evaluation crit. & correct EA if necessary. Feedback on E.C.--how well do they fit? Assess opportunities for S&W imp. proj. w/ KV and/or P&M funds.	Develop and record evaluation criteria for next entry during M&E.	Develop information for checklist. Refine original evaluation criteria to fit actual events. Apply evaluation criteria to actual situation.	Revised/new criteria from M&E results.
INVENTORY	Review existing Order 3 SRI, WRI, GRI--to detetmine if more intense inventory is needed. Determine priority for collecting data. Schedule/fund intensive inventory needed. Dig out previous works on this and similar sales.	Do not proceed w/ inv. until steps 1A&1B are firm. Collect intensive data relevant to steps 1A&1B, within timeframes allowed, & to the agreed upon intensity. Examine previous sale in this & similar areas. Develop resource data bases for the compartmnt & incorporate into forest data base. Multi-discip. Use examples of other specialists in the region as source of ideas for improving methods.	Record deviations from Mgmt Reqmts in EA. Assess need to collect more data and/or correct EA. Set guidelines to use in monitoring the decision.	Record data gathered during M&E for use in next entry.	Soil & water Order 1&2 inventories on specific sites. Collect post proj S&W data (grnd cvr density; EHR; topsoil removal; burn intensities) for resource data base. Meas road reveg; eval road location and design.	Include M&E data, last sale data in inventory.
SITUATION ASSESSMENT	Interpret existing data to assist in evaluating, establishing, and ranking concerns. Do data show marginal sites, critical microclimates, sensitive watersheds, mass wasting hazard, regeneration difficulties?	Interpret data relevant to steps 1A&1B--ie, determine soil prod., EH, WQ, water yield regime, land suitability--early in the process. Did assessmt surface new I, C,&O? If so, incorporate into 1A&1B and notify team ldr. Display data for line & ID Team. Use examples of other specists in the region for ideas on display of data. Interact w/ ID Team in data interpretation. Identify need for more data. Both multi-disciplinary and ID Team.	Train layout forester in applicatn of S&W prescrptions to specific situations. Assess credibility of S&W prescriptns. Apply forest policy. Determine need for EA corrections using results of NEPA steps 1E, 1F, and 1G.	Apply interpretation of data on the ground with the TS administrator. Analyze and interpret data gathered during M&E (erosion, compaction, sedimentatn, effective mitigating measures).	In-depth analysis of plantation sites, B.D. areas--as corrections to the original EA. Estimate recovery time to assess needs for vegetal stabilization, release from competitn; and set standards for a fully recovered S&W conditions.	Include evaluations from M&E in evaluating new sale data.
FORMULATE ALTERNATIVES	Review tentative proposed alts. Suggest broad alternatives based on your professional judgment in your specialty, using NEPA steps 1A, 1B, 1C, and 1D.	Develop alts. to meet 1A&1B. Specialists can propose different alts. as needed. Dev Mgmt Reqmts, stream protectn, soil prod., enhancemt opportunities. Resolve specialsts conflicts. Adjust step 1D to apply to adjusted alts. ID Team.	If EA corrections needed, develop new alternatives as necessary.	Develop revised and new alternatives for use in next sale during M&E.	Review and refine alternatives as stated in EA to incorporate latest technical methods. Estimate re-entry date.	Use evaluations from previous sale to help form alternatives.
ESTIMATE EFFECTS OF ALTERNATIVES	An opportunity exists here to show positive effects of your proposed alternatives.	Quantify effects--set relative signifnce levels for ea. Set qual ratings on estimates. ID Team interactn essential. Use most recent research & technlgy findngs. Improve qual of specialsts input with ES wkshps,& trng. Dev methods unique for ea forest. Rngr Dist fdbk on qual of estims.	Refine estimated effects based on actual layout vs. layout specified in the EA.	Determine and record actual effects of selected alternatives. Use in next entry and in similar sale areas in NEPA steps 1E, 1F, and 1G.	Review and refine estimates to fit actual situation. Relate specific site conditions to actual effects and accumulate in Forest data base.	Use past experience on this and similar sales.
EVALUATE ALTERNATIVES	Evaluate preliminary alternatives. Identify needs to develop new alternatives based on inventory & analysis of recon data.	Rank against criteria. Show reliable significance level. If a matrix is used, write out interpretation. ID Team assist line. Document process. Recommend preferred alt. w/ documentation. Set Mgmt Reqmts & condtns for the preferred alt.	Refine evaluations based on actual layout.	Evaluate alternatives discarded in the EA, and new ones. Record for use in this step for next entry.	Eval project as built & relate to estimate. Set performance standards for an acceptable end product. Schedule periodic maintenance.	Include results of M&E in evaluation.
DECISIONS	GO or NO GO	Line--select alt. & document. (ID Team)	Line--correct EA if necessary.	Line--change contract as needed.		
MONITOR AND EVALUATE	ID & establish post EA & harvest monitoring needed, e.g., water quality. Select sales from forest LMP to monitor (fragile soils, mass wasting hazard, critical microclimates, marginal prod, critical W.Q. areas). Try to make them represent the forest.	Determine specific M&E needs on specific areas w/in sale. Specify in Mgmt Reqmts section of EA: who/why/when/what M&E is to be done and provide blank space for initials & date M&E is done. Provide M&E in 3 areas: proj. admin., technel, and long-term.	Work w/ layout forester to check adherence to EA Mgmt Reqmts. Evaluate effectiveness of EA in achieving desired results on the ground. (See above for examples.)	Work w/ sale admin--chk compliance w/ contract provisns. Eval effectvness of EA reqmts in eliminatng resource damage during logging and preparing wtrshds to w/stand subsequent damaging forces. Participatn in TSA cert. teams on active logging operatns (see above).	Design W.Q. monitoring plan. Execute plan. Evaluate effectiveness of EA in achieving desired regeneration (see above). Level III IS Examination.	Specify changes needed in next entry. Monitor recovery rates, seedling survival, growth rates.

Table 2. Action Steps for Implementing the NEPA Process in TSPP

LETTER OF MANAGEMENT INTENT

TSPP Phase	Action Step	NEPA Step	Mode	Remarks
Position Statement	1	1C & 1D	MD	1. Gather known data, analyze and interpret.
	2	1A & 1B	MD/ID	1. Identify issues, concerns, and opportunities based on known data.
	3	1E	ID	1. Review any alternatives generated by TM. 2. ID Meeting 1 (optional).
Environ-mental Analysis	4	1A & 1B	ID	1. Re-evaluate I, C, and O from P.S. phase. 2. Present new I, C, and O if any have come up between P.S. and data collection below. 3. ID Meeting 2 (essential) held before next action step.
	5	1C & 1D	MD	1. Collect field data. 2. Analyze and interpret data. 3. Note: some of this may be in ID mode.
	6	1A & 1B	ID/MD	1. New I, C, and O plus evaluation criteria may be found after collecting field data. 2. If this occurs, resolve before taking further actions.
	7	1E,1F,&1G	ID	1. Do these three NEPA steps as a group (although keep their identity separate). Step 1F may be MD. 2. ID Meeting 3 (optional) held to cover action steps 1-7 in E.A. phase.

Table 2 (contd).

TSPP Phase	Action Step	NEPA Step	Mode	Remarks
E.A. (contd)	8	1A, 1B, 1C, & 1D	ID/MD	1. Steps 1E, 1F, and 1G may generate new I, C, and O plus evaluation criteria. 2. They also may create need for additional field work.
	9	1E,1F,&1G	ID	1. Re-evaluate based on action step 8, if that step is needed.
	10	1H	ID	1. Recommend preferred alternative to D.R. after NEPA Steps 1A-1G have been completed and/or re-evaluated as necessary. 2. ID Meeting 4 (essential) to finalize NEPA Steps 1A-1H.

PROJECT IMPLEMENTATION

1. Layout
2. Harvest
3. Post-Harvest

III. INTERDISCIPLINARY TEAM MANAGEMENT

The following table (Table 3) indicates how and when the ID Team fits into the NEPA process. It shows the relative importance of the NEPA steps at each ID Team meeting and summarizes the activities of the participants.

A. ID Team Meetings

During the planning process for each timber sale there are usually two to four ID Team meetings:

ID Meeting 1 - is held during the latter portion of the position statement phase to discuss identified issues, concerns, and opportunities and to begin to develop evaluation criteria. This meeting is optional; that is, it may not be needed on all sales or where time is short.

ID Meeting 2 - takes place in the beginning environmental analysis (E.A.) phase. It is essential that this meeting be held to give direction to the entire E.A. process. At this meeting the latest timber management proposal is office reviewed and then a field trip may be conducted to highlight important aspects of the proposed sale. The office portion will focus on issues, concerns, and opportunities; evaluation criteria; and the first approximation of project alternatives.

ID Meeting 3 - takes place in the mid-E.A. phase. It may or may not be needed, depending on sale complexity and time constraints. In addition, it may not involve all ID Team members - only those in whose disciplines problems arise. The purpose of a mid-E.A. phase meeting is primarily to revise alternatives, formulate new ones, discuss new issues, and resolve problems before they go unnoticed too long.

ID Meeting 4 - is as essential, if not more so, than Meeting 2. Its main purpose is to finalize alternatives and analyze and evaluate the effects of each. It is also important for the team to get ready to prepare the recommended preferred alternative. This meeting may involve a field trip with some or all of the members of the ID Team, but will usually end up in the office where final strategy regarding the preferred alternative is arrived at.

B. "Catch-Up" Period

During the present catch-up period, the ID Team process can still function. ID Team Meetings 2 and 4 are recommended as a minimum in order to begin and finish off the E.A. and ID Team process. Even though an ID Team may not have participated in the position statement or won't have a lot of time during the E.A. phase, all of the NEPA steps can be covered in Meetings 2 and 4. As a result, the full NEPA process and an ID Team approach to sale planning will have been implemented.

Table 3. ID Team Management

LETTER OF MANAGEMENT INTENT

Action Item	NEPA Steps	Relative Emphasis	Timing	Location	Remarks
ID Mtg 1	1A & 1B 1C & 1D 1E,1F,1G,&4 1H	High Moderate Low N/A	Position Statement Phase	Office	1. Full ID Team--anyone interested may attend. 2. D.R.--important for him to attend. 3. Meeting is office review. Emphasis is on Steps 1A and 1B.
POSITION STATEMENT WRITTEN					
ID Mtg 2	1A & 1B 1E,1F,1G,&4 1C & 1D 1H	High Moderate Low N/A	Beginning E.A. Phase	Office and Field	1. ID Team was chosen at 5-yr conference. Meet here to review latest TM proposal, then field review if needed. 2. D.R.--attendance important to "kick off" project direction for E.A.
SPECIALIST FIELD WORK PERIOD					
ID Mtg 3	1E,1F,&1G All others	High Moderate	Mid E.A. Phase	Office and Field	1. Purpose is to revise existing or formulate new alternatives to resolve new problems. 2. May be needed for only part of the team if problems are minor.
ID Mtg 4	1E,1F,&1G 1H 1C & 1D 4 1A & 1B	High High Moderate Moderate Low	Late E.A. Phase	Office and Field	1. ID Team meets to finalize Steps 1E-1H. May involve more than a single meeting. Major mtg will usually end up in office. 2. D.R.--important for him to attend for Steps 1G&1H, and for ground review before ID Team recommends the preferred alternative.
EA PREPARED AND APPROVED					

C. Key Points in ID Team Management

1. Role of team leader - Must organize and manage the team activities. Must facilitate, not dominate.

2. Characteristics of team leader - Must be a driving force to get the job done; he must be able to keep team on track, and realize that a great deal of work must be done in a limited amount of time.

3. Line involvement - Line must be involved throughout the ID Team process to give the team direction and show confidence in the team. Much of the success of an ID Team can hinge on the amount and quality of line commitment.

4. Team members - Must attend meetings and be prepared, by doing necessary office and/or field work ahead of time. Must be willing to cooperate as a team member, not have the attitude that his or her discipline is the only one that counts. Another very important point is that the team's role is to recommend and not to decide. For example, team members should state the effects of implementing each project alternative rather than saying yes or no for implementing the alternatives. Line will do the decision making.

IV. Appendix

Examples from Regional, Forest and District Working Documents

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IV. Appendix

Examples from Regional, Forest and District Working Documents

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Appendix A. Issues, Concerns, and Opportunities

Generally issues, concerns, and opportunities focus on the following as they relate to earth resources:

- What is the productivity of the land?
- What are the beneficial uses of the water?
- What is the erodibility of the site?
- What is the water quantity and quality of the site?
- What is the land stability of the site?
- What are the accumulated effects of proposed actions on soil productivity and water quality?

Following is a more detailed discussion of issues, concerns, and opportunities.

There are two kinds of issues/concerns: those dealing with the capability of the site or area to produce or support the intended resource(s) or program, and those dealing with the effects of the program or activity on the earth resources. "Opportunities" refers to the opportunity to improve the productivity or quality of the earth resources.

The following lists of issue/concern and opportunity terms are offered as thought triggering items. When responding to a proposed project, management plan, or whatever (i.e., letter of management intent), each of the items listed should be seriously considered and documented as being, or not being, an issue/concern or opportunity. This may be done by constructing a table of the items and checking yes or no.

ISSUES/CONCERNS RELATIVE TO CAPABILITY

Soil Productivity
- soil characteristics
- macroclimate
- microclimate

Water Yield
- quantity
- timing
- climate

Water Quality
- sediment
- nutrient
- temperature
- other

Land Stability
- faults (seismic)
- geologic strata
- slope
- etc.

Importance of Issues and Concerns

Importance is included here because of the specific need to determine and document the importance, risk, or emphasis of each identified issue/concern and opportunity. This importance factor is needed to help determine what evaluation criteria are to be used as well as the kind and detail of data to be collected. The importance factor will also help determine the disciplines needed on the interdisciplinary team.

The importance factor is somewhat of a subjective rating (low, moderate, high) based on the potential of the project or program, on-site or off-site situation (e.g., ability to be revegetated, municipal watershed, etc.), Forest objectives, standards, and applicable laws or regulations. The importance factor is first determined by the earth scientist, who obviously must have a good knowledge of the forest conditions, situations, objectives, laws, etc. This factor is then discussed with and approved by the line officer.

Appendix B. Evaluation Criteria

Evaluation criteria can be obtained from many sources. Some of these follow:

Laws and Regulations (examples)

In addition to the criteria listed in NFMA regulations consider national, State, and local laws and standards relating to water and soil, such as:

-- It is the national goal that the discharge of pollutants into navigable waters be eliminated by 1985; Section 101(A)(1), P.L. 92-500.

-- It is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish and shellfish, wildlife and provides for recreation in and on the water be achieved by July 1983; Section 101(A)(2), P.L. 92-500.

-- Each Department, Agency...of the Federal Government (1) having jurisdiction over any property or facility, or (2) engaged in any activity resulting...in any discharge of runoff of pollutants shall comply with Federal, State, Interstate and local requirements of respecting control and abatement of pollution...; Section 313, P.L. 92-500; also similar Executive Order 11-752.

-- Recognize the fundamental need to protect, and where appropriate, improve the quality of soil, water, and air resources; Section 4(5)(c), NFMA, P.L. 94-588.

-- Each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands; Section 1(A), Executive Order 11990.

-- Each agency shall provide leadership and take such action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains; Section 1, Executive Order 11988.

Forest Objectives and Policy (examples)

-- Restore stream channels damaged by past management activities.

-- Maintain water quality at least to State standards or present beneficial use, whichever is applicable.

-- Restrict soil compaction to less than 15 percent of the forest under intensive management.

-- Do not accelerate soil loss above natural rates of soil formation.

Expressions of How Criteria Are to be Measured (examples)

-- Water Quality Standards = Do not increase suspended sediment in water by more than 15 percent above background.

-- Water Yield measured in AF/Acre.

-- Sediment measured in Tons/Mi^2.

-- Erosion hazard measured according to FSM 2550, R-5 Supplement #18.

-- Water meeting quality standards measured in AF/Yr, MIH 1309.11 #12.

-- Numerical values/rankings are often used when quantitative values are not available.

Criteria for Evaluating Alternatives

Following are examples (used on the Klamath National Forest, Happy Camp Ranger District) for ranking impacts of alternatives on various items.

CRITERIA

RATING	IMPACT OF PROPOSED ALTERNATIVE
	CULTURAL RESOURCES
0	No sites are known. The area has a low sensitivity (not projected to contain Archeological sites).
1	No impact will occur on known sites. Areas of medium and high sensitivity may experience Indirect Impact.
2	Known sites will not experience Direct Impact but may experience Indirect Impact. Areas of high sensitivity may experience Indirect Impact. Moderately sensitive areas will be directly impacted.
3	Known sites will not experience Direct Impact but may experience Indirect Impact. High sensitivity areas <u>will</u> experience Direct Impact.
4	Known sites <u>will</u> experience Direct Impact.

CRITERIA

> greater than ≥ greater than or equal to
< less than ≤ less than or equal to

RATING	IMPACT OF PROPOSED ALTERNATIVE	
	MASSIVE LANDSLIDES	DEBRIS FLOW LANDSLIDES
0	(a) ≤1 significant Management related slide/30 ac. disturbed land. (b) <50 yds.^{3} per landslide. (c) Existing and potential slides usually don't enter flowing draws.	(a) ≤1 significant Management related slide/30 ac. disturbed land. (b) <50 yds.^{3} per landslide. (c) Existing and potential slides usually don't enter flowing draws.
1	(a) ≤1 significant Mgmt related slide/15 ac. disturbed land. (b) ≤50 cu. yd. per landslide. (c) Existing & potential slides may enter flowing draws.	(a) ≤1 significant Management related slide/15 ac. disturbed land. (b) ≤50 cu. yd. per landslide. (c) Existing & potential slides may enter flowing draws.
2	(a) ≤1 significant Management related slide/12 ac. disturbed land. (b) ≤200 cu.yd. per landslide. (c) Existing/potential slides enter flowing draws; gutting does not include entire segments.	(a) ≤1 significant Management related slide/12 ac. disturbed land. (b) ≤200 cu.yd. per landslide. (c) Existing/potential slides enter flowing draws; gutting does not include entire segments.
3	(a) ≤1 significant Management related slide/10 ac. disturbed land. (b) ≤500 cu.yd. per slide. (c) Existing and potential slides enter flowing draws, gutting entire segments--road prisms are not lost.	(a) ≤1 significant Management related slide/10 ac. disturbed land. (b) ≤500 cu.yd. per slide. (c) Existing and potential slides enter flowing draws, gutting entire segments--road prisms are not lost.
4	(a) >1 significant Management related slide/10 ac. disturbed land. (b) >500 yds.^{3} on some slides. (c) Existing/potential slides enter flowing draws; some entire reaches are gutted, and entire road prisms are lost.	(a) >1 significant Management related slide/10 ac. disturbed land. (b) >500 yds.^{3} on some slides. (c) Existing/potential slides enter flowing draws; some entire reaches are gutted, and entire road prisms are lost.

CRITERIA

IMPACT OF PROPOSED ALTERNATIVE

AREA

RATING

FUEL LOADING

PRODUCTIVITY REDUCTION

RESISTANCE TO CONTROL

Soils Fuels

This soil productivity reduction rating considers the impacts of nutrient and available water capacity losses resulting from soil erosion or scalping, plus logging caused soil compaction on potential soil productivity. Factors considered are total erosion rating, soil depth, soil texture, and harvest or site preparation methods.

SMS Soil Unit	Productivity Reduction Rating Total Erosion Rating 0	1	2	3	4
341	0	1	2	3	4
344	0	1	2	3	4
345	0	1	2	3	4
348	0	1	1	2	3
636	0	0	0	1	2
639	0	0	0	0	1
641s	0	1	2	3	4
644s	0	1	2	3	4
645	0	1	1	2	3
646	0	0	1	1	2
(645-646)s	0	1	1	2	3
661s	0	1	2	3	4
664s	0	1	2	3	4
665	0	1	1	2	3
(665-666)s	0	1	1	2	3
939	0	0	0	1	2
R	-	-	-	-	-
E	-	-	-	-	-

Add 1 to rating for tractor clearcutting or slash piling. Also add 1 to rating for tractor scalping (except brushrake).

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE
		ESTABLISHMENT POTENTIAL
Soils	0	Total score of 5 - 6
	1	7 - 9
	2	10 - 12
	3	13 - 15
	4	16 - 24

Average annual precipitation in the sale area is approximately 50 inches.

SMS Map Unit	24" AWC (in.)	Establishment Potential Rating NW - NE Total/Rating	W - NW NE - SE Total/Rating	W - SE Total/Rating
341	1.4	14 - L (3)	15 - L (3)	17 - VL (4)
344	2.2	11 - M (2)	12 - M-L(3)	14 - L (3)
345	2.4	10 - M (2)	11 - M (2)	13 - L (3)
348	2.5	10 - M (2)	11 - M (2)	13 - L (3)
636	3.4	6 - VH (0)	7 - VH (0)	9 - H (1)
639	3.2	6 - VH (0)	7 - VH (0)	9 - H (1)
641s	1.0	14 - VL (4)*	15 - VL (4)*	17 - VL (4)
644s	2.0	12 - L (3)*	13 - VL (4)*	15 - VL (4)*
645	2.6	10 - M (2)	11 - M (2)	13 - L (3)
646	2.4	10 - M (2)	11 - M (2)	13 - L (3)
(645-646)s	2.4	10 - L (3)*	11 - L (3)*	13 - VL (4)*
661s	1.0	14 - VL (4)*	15 - VL (4)*	17 - VL (4)
664s	2.0	12 - L (3)*	13 - VL (4)*	15 - VL (4)*
665	2.6	10 - L (3)*	11 - L (3)*	13 - VL (4)*
(665-666)s	2.4	10 - L (3)*	11 - L (3)*	13 - VL (4)*
939	3.0	7 - H (1)	8 - H (1)	10 - M (2)
R		Ø	Ø	Ø
		Ø	Ø	Ø

*Reduced one class because of very rocky surface.

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE	
		FUEL LOADING	RESISTANCE TO CONTROL
Fuels	0	Less than 6 tons per acre	Greater than 3.5 chains per man hour
	1	6 to 8 tons per acre	2.6 to 3.5 chains per man hour
	2	8 to 10 tons per acre	1.4 to 2.5 chains per man hour
	3	10 to 12 tons per acre	0.6 to 1.3 chains per man hour
	4	Greater than 12 tons/acre	Less than 0.6 chains per man hour
		The tons/acre is in the 0-3" category only. It is derived by the planar intersect method developed by James K. Brown of the Intermountain Forest & Range Experiment Station, Ogden, Utah (USDA Forest Service General Technical Report INT-16, September 1974). The tons/ac. figure is natural accumulation of dead and down material. The post sale residue should increase in direct proportion to this figure. Material greater than 3" was not used as it is best reflected in the Resistance to Control index.	These figures are based on the amount of fireline one man can construct and hold in one hour. They are derived from the Resistance to Control descriptions in the Forest Service Manual 5151.14--1.

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE
		TREATMENT FEASIBILITY
Fuels	0	Meets all MM standards and fuel treatment can be effectively* applied.
	1	Meets all MM standards and fuel treatment can be effectively* applied to 75% of logged area.
	2	MM standards may be met and 50% of logged area cannot be effectively* treated.
	3	MM standards cannot be met and 75% of logged area cannot be effectively* treated.
	4	Does not meet MM standards and no effective* fuel treatment can be applied.

*Effective = treatment can be accomplished within three years of sale termination and cost is within $50.00 to $200.00 per acre.

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE			
		STREAM TEMPERATURE			FISHERIES
		basin(stream) cardinal direction and aspect of treatment unit adjacent to perennial stream	angular crown density reduction adjacent to perennial streams (%)	lineal distance of perennial stream affected (feet)	average of stream stability, sediment and turbidity, and stream temperature ratings for treatment unit (≥.5 round up)
Hydrology and Fisheries	0	N, & SW NE & SW E & SE all south aspects	<1	<25	0
	1	S & SW SW & SW,W,NE,E,SE W & SW,SE NW & SW,W N & W,NW,N,NE,E,SE NE & W,NW,E,SE E & SW SE & SW,W,SE	1-5	25-50	1
	2	S & W,NW,N,SE SW & NW,N W & W,E NW & NW,SE NE & N,NE E & W,E SE & NW,E	6-15	51-120	2
	3	S & NE,E SE & N,NE NW & N,NE,E	16-40	121-250	3
	4	W or E & NW,N, or NE	>40	>250	4

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE						
		STREAM STABILITY			SEDIMENT AND TURBIDITY			
		influence of treatment on increasing instability (descriptive)	resultant equivalent clear-cut area (%)	resultant channel stability rating (USFS R1)	drainage density, road density (mi./sq.mi.)	riparian vegetation loss (%)	increase in total sediment production (orders of magnitude)	impact on channel source sediment (descriptive)
Hydrology and Fisheries	0	no influence	<10	<77 (good)	<1	<1	<0.5	no noticable effect.
	1	small factor	10-20	77-88 (fair+)	1-2	1-5	0.5-1	minor pool filling, minor expansion of point and channel bars, little increase in size or freq. of bank failures, scour at curves and constrictions only.
	2	contributing factor	21-40	89-102 (fair) intensive instability	2-4	5-15	1	some pool filling, noticable expansion of bars, some increase in size or freq. of bank failures, scour discontinuous (≤40% lineal stream distance).
	3	large factor	41-70	103-115 (fair-) extensive instability, intensive high instability	4-7	15-30	2	pools partially filled, bars greatly expanded, < 50% increase in size or freq. of bank failures, scour freq. (40-75% lineal stream distance).
	4	prime factor	>70	>115 (poor) extensive high instability	>7	>30	3	pools completely filled, sediment traps overflowing, channel bottom level with sediment, >50% increase in size or freq. of bank failures, scour continuous (>75% lineal stream distance).

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE
		ROAD MAINTENANCE
Engineering	0	Self maintaining roads.
	1	Level 3 roads with no problems.
	2	Small slide (under 500 cubic yards of slide removal to keep open).
	3	Will require slide removal of 20% of road length every year (over 500 cubic yards to keep open).
	4	The road will not stay in place even while building. Road will never be used because of slides, drainage problems and plugged pipes.

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE
		ROAD FEASIBILITY
Engineering		The road must be feasible in the sense that we know how to accomplish it technically, and it must be feasible in the sense that needed funds and manpower are available.
	0	Grades of 0-8%; side slopes 0-5%. Flat terrain; difficult to drain roads.
	1	Grades of 0-12%; side slopes 5-30%. Minimum impact and road cost.
	2	Grades of 12-15%; side slopes 30-50%. Stabilized ground; horizontal alignment not much of a problem.
	3	Grades of 15-18%; side slopes 50-75%. Small slide areas; minimum radius curves 50-75 feet.
	4	Grades over 18%. Tunnels required. Large bridges or enormous drainage structures. Crossing large slides. Curve radius less than 50 feet.

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE
		ECONOMIC ANALYSIS
Engineering		The road must produce additional output or satisfaction at a reasonable cost. Some roads, although they are feasibly productive and acceptable, are so costly in terms of what they provide that they must be rejected on this basis.
	0	A cost benefit ratio greater than 1. Accept project.
	4	A cost benefit ratio of less than 1. Construction costs would outweigh any future timber to be harvested over the road.

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE
		TIMBER STAND IMPROVEMENT
Silviculture		Costs incurred to create regeneration, protect residual, etc.
	0	Few or no additional TSI costs anticipated after cutting. Mechanical site preparation needed on less than 20% of ground for natural regeneration.
	1	Either one precommercial thinning or one release operation likely. Twenty percent of clearcut acres are planned for tractor site preparation with ripper - increased survival and growth. Mechanical site prep on less than 50% of acres for natural regeneration. Residual tree painting needed after thinning. Underburning necessary for site preparation.
	2	Both release and precommercial thinning needed. Site preparation of over 50% of acres for natural regeneration. Light gopher or mountain beaver (Boomer) population - possible animal control. Over 20% of clearcut acres planned for tractor site preparation with ripper and planting. Reburning of site may be necessary to get natural regeneration (or partial mechanical site prep).
	3	Precommercial thinning and multiple release needed. Heavy brush falling necessary prior to underburning. Hand mechanical and/or chemical release necessary to release seedling-pole conifer stand. Over 50% of clearcut acres planned for tractor site preparation and planting. Heavy local or moderate area populations of gophers or "boomers". Moderate slash fire risk after treatment. Mechanical site prep with moderate slash reduction cost.
	4	Very difficult hardwood (brush-tree situation). Extreme hardwood-brush-tree falling prior to underburning. Heavy cost of hand mechanical and/or chemical release of seedling-pole conifer - usually also risk of dead hardwood falling on conifer. High risk of slash fire after treatment. Clearcut in an area of heavy gopher or "boomer" population. High probability of replanting site to make a minimum acceptable stand. Heavy slash reduction and site prep cost. Risk of replanting.

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE
		REGENERATION POTENTIAL
Silviculture		An adequate stocking of 220 well distributed crop trees per acre on over 60% of acres regenerated. Can be reduced to 100-150 well distributed crop trees/acre - 60% of acres regenerated. Reduction indicated by an asterisk (*).
	0	Adequate stocking can be accomplished on over 70% of the acreage to be regenerated - within five years.
	1	Adequate stocking can be accomplished on 50-70% of the acreage to be regenerated - within five years.
	2	Adequate stocking can be accomplished on less than 50% of the acreage to be regenerated - within five years.
	3	Assurance that adequate stocking can be accomplished within five years is questionable.
	4	No assurance that adequate stocking can be obtained within five years.

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE
		STAND MANAGEMENT PRESCRIPTION OBJECTIVE
Silviculture		Criteria: What percent of the stand is estimated to have 60% or more of the area stocked at 50% or more of yield stocking--a visibly manageable stand--though possibly clumpy.
	0	SMPO will be met on all acres. Cutting greatly improves previous cutting. Excellent timber management.
	1	SMPO will be met on over 70% of the treatment acreage. Acceptable--good timber management. Prescription and SMPO met on a somewhat scattered, clumpy stand. Improves previous cutting somewhat.
	2	SMPO will be met on over 50% of the treatment acreage. Fair-marginal timber management. Cutting leaves poor units for next entry. Part of SMPO and/or prescription not met. Some loss of stocking by logging damage (non-stocked holes). Regeneration cutting adjacent to stand of previous age class. Cutting will hurt cutting volume in next entries. SMPO and prescription met on a very scattered, clumpy stand. Questionable amount of regeneration cutting (over 20% of standard or special component in compartment this cutting cycle).
	3	SMPO will be met on over 25% of the treatment acreage. Poor timber management. Much of SMPO and prescription not met. Cutting leaves uneconomical units for next entry. Regeneration cutting adjacent to stands of the same age class. Large loss of stocking by logging damage (non-stocked holes). Cutting will hurt future volume for next several entries. Excessive amount of regeneration cutting (over 30% of standard or special component in compartment this cutting cycle). Clearcuts in pattern that creates area of 1-2 age class (take out leave units between clearcuts).
	4	SMPO cannot be met. Not timber management. Defeats SMPO and prescription. Unreasonable loss of stocking. Stand high-graded. Cutting unnecessarily leaves clearcutting as only future choice. Extreme regeneration cutting (over 40% of standard or special component in compartment this cutting cycle).

CRITERIA

RATING	IMPACT OF PROPOSED ALTERNATIVE
	VISUAL QUALITY OBJECTIVE
0	VQO met or exceeded. (Index = A x B x C, where A = number of steps decreased in Visual Quality from VQO B = % of activity not meeting VQO C = # of years to recovery of original VQO).
1	Index < 99
2	Index = 100 -> 299
3	Index = 300 -> 500
4	Index $\geq$ 500

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE
		HARVEST FEASIBILITY
Harvest Feasibility		Achieving the desired results will be:
	0	No problem
	1	very likely with normal efforts such as endlining, adverse skidding
	2	likely with additional efforts such as rigging tail trees, bench skid trails, directional felling
	3	difficult due to the: a) need for an intermediate support b) need to downhill yard under conditions which do not permit control of turns c) lack of guyline anchor stumps d) very broken topography
	4	doubtful due to: a) steep slopes causing logs to roll in situations where the residual stand must be protected b) lack of realistic tailholds c) the requirement for more than one intermediate support d) the cumulative effects of several factors mentioned in other ratings e) unsafe conditions

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE	
		BURN INTENSITY	BYRAM INTENSITY
Fuels	0	Marginal fire; flame length 2 ft.	0 - 100
	1	Prescribe burn level; flame length 4 ft.	100 - 300
	2	Controllable by conventional methods; flame length 4 ft - 8 ft.	300 - 500
	3	Maximum limit of control for initial attack; flame length 9 ft - 12 ft.	500 - 700
	4	Major conflagration potential present, unacceptable level of slash buildup; flame height in excess of 12 ft.	700+

CRITERIA

> GREATER THAN < LESS THAN

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE		
		STREAM STABILITY	STREAM TEMPERATURE	STORM FLOW TURBIDITY
Watershed	0	Future activities not a contributing factor to instability.	No effect.	No effect.
	1	Future activities contributing but not prime factor in instability. Sediment increase less than 10 times.	<1% crown density reduction of streamside areas.	No loss riparian vegetation.
	2	Future activities large factor but not prime factor in causing instability. Sediment increase by 10 times.	1-5% crown density reduction of streamside areas.	1-5% loss riparian vegetation.
	3	<10% streams likely to be destabilized. Sediment increase by 100 times.	5-10% crown density reduction of streamside areas.	5-25% loss riparian vegetation.
	4	>10% streams likely to be destabilized. Sediment increase by 1000 times.	10% crown density reduction of streamside areas.	>One road crossing/1000' stream. >25% loss riparian vegetation. >One acre road surface draining directly to streams.

CRITERIA

AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE
Fisheries	0 thru 4	Fisheries habitat and population is directly related to Stream Stability, Water Temperature and Storm Flow Turbidity. Long term changes in habitat are more important than short term changes; therefore, the numerical rating for Fisheries is a weighted average of Stream Stability (weight = 2), Water Temperature (weight = 1), and Storm Flow Turbidity (weight = 1).

CRITERIA

Based on Wildlife study done by Larry Forbis (S.O. Wildlife Biologist) and California Department of Fish and Game.

AREA: Wildlife

RATING

IMPACT OF PROPOSED ALTERNATIVE

POPULATION RESPONSE

RATING	ACTIVITY	LONG TERM RESPONSE OF WILDLIFE POPULATIONS	SPECIES
0	Forest Roads Only	High	Marten
1	Partial Cut	High	Marten - Fisher
2	10% Patch Cut	Extreme	Pileated Woodpecker
		High	Marten - Fisher
3	20% Patch Cut	Extreme	Pileated Woodpecker
		High	Marten - Fisher - Great Gray Owl
4	50% Patch Cut	Extreme	Pileated Woodpecker - Marten - Fisher
		High	Opossum - Black Bear - Pacific Water Shrew - Raccoon - Chickaree - Western Gray Squirrel - Spotted Owl - Great Gray Owl - Bushy Tail Wood Rat - Dusky Footed Wood Rat

EXTREME - Violent reduction in Density. Changes will probably be manifested in one or two life cycles (one season for most rodents, 10-15 years for bears).

HIGH ---- Noticeable reduction in density over short periods of time (10-20 years). Can lead to decimation of population if stress continues.

THIS EVALUATION IS BASED ON HABITAT CHANGES. ACTUAL OCCURRENCE OF SPECIES IS NOT ADDRESSED.

CRITERIA

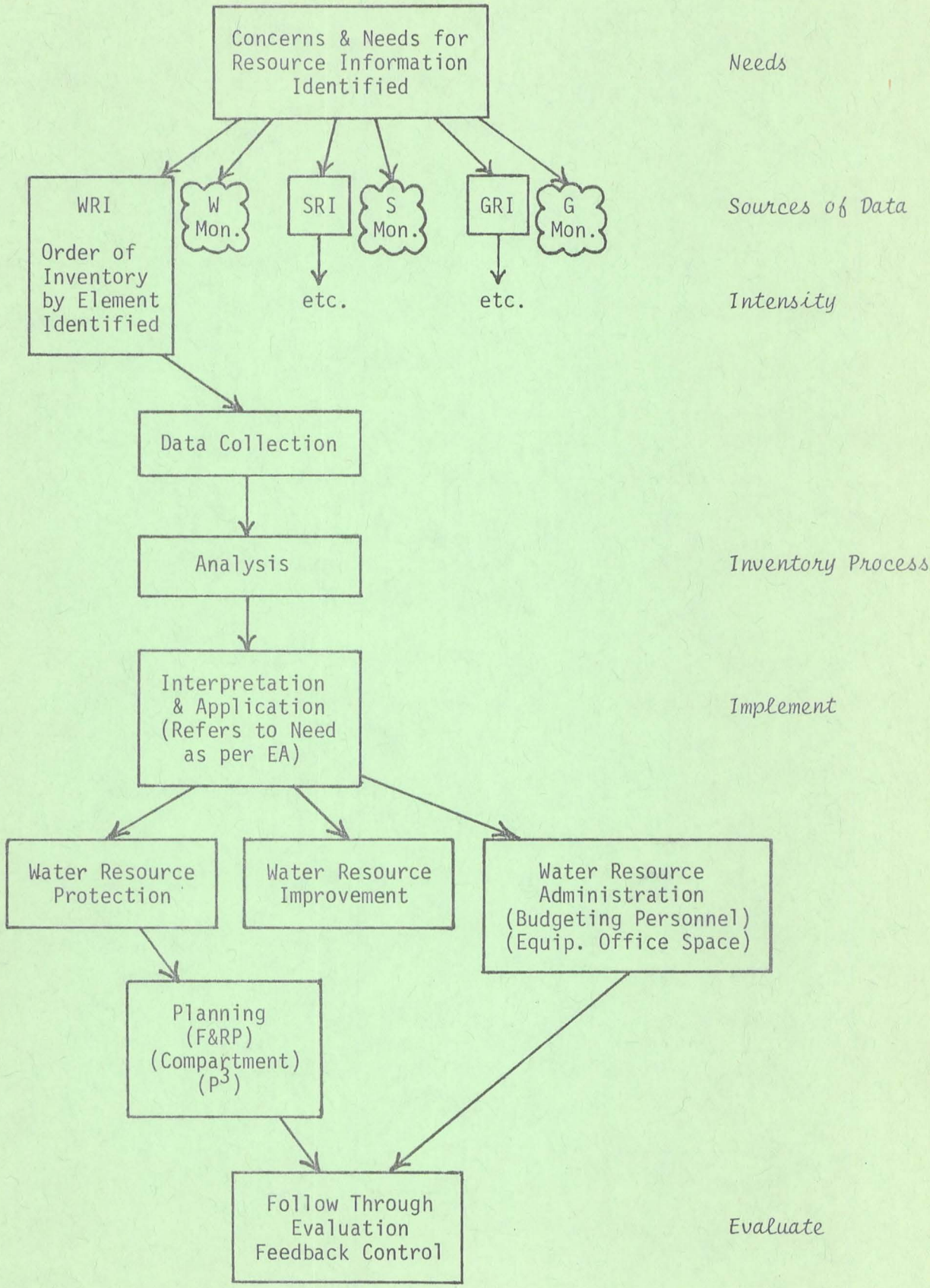
AREA	RATING	IMPACT OF PROPOSED ALTERNATIVE
		RARE & ENDANGERED SPECIES
Wildlife	0	No known or suspected habitat of rare or endangered species.
	4	Known or suspected Bald Eagle nesting areas; known or suspected Peregrine Falcon aeries--cliffs or sheer rock outcrops that extend well above overstory. Known or suspected Wolverine habitat - Crest-Montane interface. Known or suspected habitat of other rare and endangered species.

Appendix C. Inventory

Refer to:

-- Material in "Watershed Resource Management" Blue Book Inventory Section.
-- FSH 2509.14, Soil Resource Inventory Procedures.

FLOW DIAGRAM OF INVENTORY TOOLS

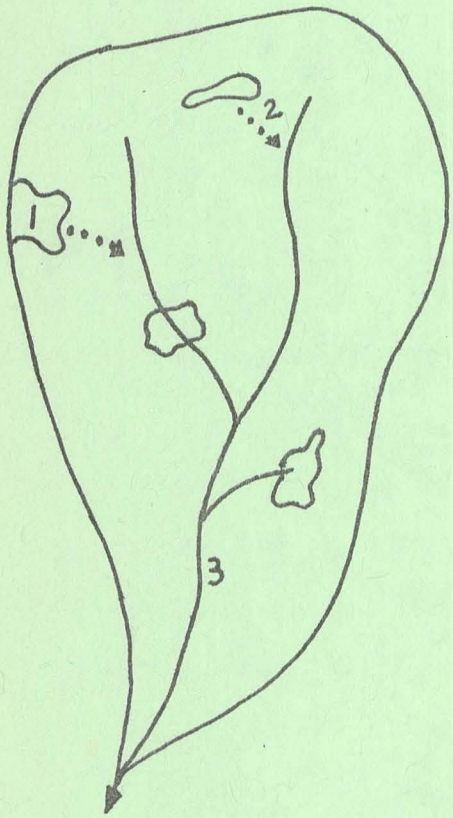


Appendix D. Situation Assessment

Analysis of data should lead to answering questions or concerns established in steps 1A and 1B of the NEPA process. To facilitate communications with users of earth resource information, the following information on analysis was developed.

A. Watershed Components

The watershed can be divided into the on-site, site-yield, and stream system components to facilitate selection of meaningful resource questions and factors for making allocation and management decisions.



1. On-site - those factors that pertain to a given piece of land and/or water and affect only that particular piece of land and/or water.

2. Site-yield - those factors that deal with products yielded from on-site, determined by either quantitative or qualitative measures.

3. Stream system - those factors that deal with the integrated effect of the on-site and site-yield components for specified segments of the drainage system (usually order two streams and larger).

B. Analysis of Earth Resource Information

The QRD (question-rule-data) process can be used to determine what type of analysis is required and what type of data is needed to support the analysis.

1. What is the productivity of the land unit?

   Definition

   Productivity is defined as the natural ability of the land unit to produce a given amount of biomass per unit of time (timber, grass, sagebrush, etc.).

Rule

Productivity is a function of the following resource factors or process:

P = f (soil characteristics and climate) = biomass production

Soil characteristics most commonly evaluated are:

a. Available water holding capacity as governed by depth, texture, coarse fragments, and bulk density.
b. Fertility.
c. Soil temperature.
d. Drainage.

Climatic factors considered are:

a. Elevation.
b. Aspect.
c. Precipitation expressed in amount, distribution, and form.

2. What is the productivity of the surface water?

Definition

Productivity is defined as the natural ability of the water unit to produce a given amount of biomass per unit of time (fish, algae, birds, etc.).

Rule

Productivity is a function of the following factors or processes:

P = f (sedimentation, water quality (chemical and biological), volume, and temperature)

3. What is the erodibility of the site?

Definition

Erodibility will include surface, mass wasting, and channel in a qualitative and quantitative sense.

Rule

Erosion is a function of the following:

Surface = f (detachability, infiltration, permeability, surface rock, vegetative cover, precipitation, and slope)

Mass Wasting = f (landform, lithology, structure, and drainage)

Channel = f (gradient, side slope, channel debris, lithology, structure, water yield, and channel condition)

4. What types and amounts of materials are transported from land and/or water units?

Definition

Material and transport mechanisms are defined in Table 1 and are materials that are transported from their original location.

Table 1

Material Yielded	Transport Mechanism														
	Fall	Ravel	Creep	Overland	Subsurface	Ground	Slurry	Slide	Debris Torrent	Roll	Entrainment	Precipitation	Direct Application	Leaching Solution	Avalanche
Sediment															
Inorganic		x	x	x			x	x			x				
Debris															
Organic	x							x		x	x				x
Inorganic						x	x	x	x	x	x				
Solutes															
Organic			x	x	x								x	x	
Inorganic			x	x	x							x	x	x	

Rule

Sedimentation is a function of the following resource factors or process:

S = f (erosion and delivery coefficient)

Debris production is a function of:

DP = f (vegetative cover, geologic material, weathering, and slope)

Solutes are a function of the following:

Sol. = f (sedimentation, introduced materials (toxic chemicals and biological decomposition))

5. What is the quantity and timing of water yield from land and water units?

Definition

Water quantity prediction will be in terms of:

a. Total quantity from a land and/or water unit.
b. Size (quantity) of instantaneous peaks per unit of time.
c. Timing of instantaneous peaks - the time span during which a peak flow event occurs.

Rule

Water yield is a function of:

WY = f (precipitation intensity, distribution, and form; vegetation; soils and geology; slope; and drainage density)

6. What is the runoff at any given point in the watershed?

Definition

Water quantification will be in terms of a stream or lake water balance for volume and time.

Rule

The water balance is a function of the following:

WB = f (precipitation, evapotranspiration, change in storage, deep seepage, impairments (storage and direct diversion), runoff, and time)

7. What are the accumulative effects on the channel geometry and streambed composition of materials and water yielded from land and water units at any given point in the watershed?

Definition

Yield consists of transported materials and water as defined for question 4.

Rule

Channel geometry and streambed composition is a function of the following resource factors or processes:

CGSC = f (gradient, streambed or bedrock geology, streambanks/side slope, and water yield)

8. What are the accumulative effects on water quality of materials and water yielded from land and water units at any given point in the watershed?

Definition

Yield consists of transported materials and water as defined for question 4.

Rule

Water quality is a function of the physical, chemical, and biological constituents of the stream and the beneficial use:

H_2O Qual. = f (sedimentation, solutes, water pathogens, yield, temperature, timing, and beneficial use)

References

Methodologies for making various interpretations are continued in:

-- Draft FSH 2509.14, R-5 Supplement
-- WRENS

Appendix E. Formulate Alternatives

(Space available here to
place your examples.)

Appendix F. Estimate Effects of Alternatives

Estimating the effects of alternatives should utilize the same methods and procedures established for analysis and interpretation used in step 1D of the NEPA process. Changes in soil, water and geology resources result in changes in one or more of the factors used to determine the present situation (NEPA step 1D).

For example:

-- Natural land productivity can be modified by compacting soils (changing bulk density) and/or loss of soil due to erosion or displacement.

-- Natural productivity of water can be modified by changing temperature, volume, suspended sediments and chemical contents of the water.

-- Geologic erosion rates can be accelerated by changes in vegetative cover and infiltration rates; changes in geologic structure balance and internal slope drainage; and changes in stream channel geomorphology and volume of water flow.

-- Water flow can be modified by changing vegetative cover density and increasing drainage density from road development and associated drainage structures.

Appendix G. Evaluate Alternatives

LISTING OF RATINGS BY INDIVIDUAL TEAM MEMBERS

	MORAINE GEOMORPHIC RESPONSE UNIT	CUT UNIT RATING BY ALTERNATIVE MAXIMUM ALTERNATIVE 1 2 3 4 5 6 7	A 1 2 3 4 5 6 7	B 1 2 3 4 5 6 7
SILVI	Stand Management Prescription Objective	1 1 2 3 3 2 1	1 1 2 2 2 2 1	2 1 2 2 2 2 1
	Regeneration Potential	1 1 0 0 0 0 1	1 1 0 0 0 0 1	1 1 0 0 0 0 1
	Timber Stand Improvement	1 1 4 4 4 4 1	1 1 4 4 4 4 1	1 1 4 4 4 4 1
WATERSHED	Stream Stability	0 0 2 4 3 3 1	0 0 0 0 0 0 1	1 0 0 0 0 0 1
	Storm Flow Turbidity	1 1 4 4 4 4 2	1 1 1 1 1 1 1	1 1 1 1 1 1 1
	Stream Temperature	2 2 4 4 4 4 2	2 2 0 0 0 0 2	2 0 0 0 0 0 2
GEOLOGY	Debris Flow	1 1 3 4 3 2 1	1 1 2 2 2 2 1	1 1 2 2 2 2 1
	Massive Landsliding	0 0 1 2 1 1 0	0 0 1 1 1 1 0	0 0 1 1 1 1 1
	Road Assoc. Failures	1 1 2 2 2 2 1	1 1 2 2 2 2 1	1 1 2 2 2 2 1
SOILS	Establishment Potential	– – 2 2 2 2 –	– – 2 2 2 2 –	– – 2 2 2 2 –
	Productivity Loss	0 1 1 1 1 1 2	0 1 1 1 1 1 2	0 1 1 1 1 1 2
	Surface Erosion	0 1 1 1 1 1 2	0 1 1 1 1 1 2	0 1 1 1 1 1 2
ENGINEERING	Economic Analysis			
	Maintenance			
	Feasibility			
FUELS MGMT	Fuel Loading	2 1 1 1 1 1 2	2 1 1 1 1 1 2	2 1 1 1 1 1 2
	Resistance To Control	2 2 2 2 2 2 3	2 2 2 2 2 2 3	2 2 2 2 2 2 3
	Treatment Feasibility	2 2 2 2 2 2 3	2 2 2 2 2 2 3	2 2 2 2 2 2 3
	Archaeology	3 3 2 2 2 2 2	3 3 2 2 2 2 2	3 3 2 2 2 2 2
	VRM (Visual Resource)	1 1 3 3 3 3 1	1 1 3 3 3 3 1	1 1 3 3 3 3 1
	Fisheries	1 1 3 4 4 4 1	1 1 0 0 0 0 1	1 1 0 0 0 0 1
	Volume Objective			
WILDLIFE	Population Response	2 2 2 2 2 2 2	2 2 2 2 2 2 2	2 2 2 2 2 2 2
	Rare & Endangered Species	0 0 0 0 0 0 0	0 0 0 0 0 0 0	0 0 0 0 0 0 0
	Harvest Feasibility			

RATINGS AGREED ON BY INTERDISCIPLINARY TEAM

MORAINE		SUMMARY RATING BY ALTERNATIVE								
GEOMORPHIC RESPONSE UNIT		MAX	A	B						
SILVI	Stand Management Prescription Objective	2	1	1						
	Regeneration Potential	1	1	1						
	Timber Stand Improvement	3	3	3						
WATERSHED	Stream Stability	3	0	0						
	Storm Flow Turbidity	4	1	1						
	Stream Temperature	4	2	2						
GEOLOGY	Debris Flow	3	2	2						
	Massive Landsliding	1	1	1						
	Road Assoc. Failures	2	2	2						
SOILS	Establishment Potential	—	—	—						
	Productivity Loss	1	1	1						
	Surface Erosion	1	1	1						
ENGINEERING	Economic Analysis									
	Maintenance									
	Feasibility									
FUELS MGMT	Fuel Loading	1	1	1						
	Resistance To Control	2	2	2						
	Treatment Feasibility	2	2	2						
	Archaeology	3	3	3						
	VRM (Visual Resource)	3	3	3						
	Fisheries	4	1	1						
	Volume Objective									
WILDLIFE	Population Response	3	3	3						
	Rare & Endangered Species	0	0	0						
	Harvest Feasibility									

The following three tables are from:

U.S.D.A. FOREST SERVICE
ENVIRONMENTAL ANALYSIS
OF MAMMOTH COUNTY WATER DISTRICT'S
WATER MANAGEMENT PLAN
Sept. 30, 1977

VI. ALTERNATIVE SELECTION

The following tables are a summary comparison of the capability of each alternative to meet the selection criteria (See page 3):

S = Satisfactory

U = Unsatisfactory

CRITERION 1 - DEALING WITH THE ISSUES AND CONCERNS

	Original Proposal	No Project	Lakes George & Mary	Wells	New Storage Reservoir	Outside Water	MCWD Final Proposal	AGENCY Combination
ISSUE	ALT. A	ALT. B	ALT. C	ALT. D	ALT. E	ALT.F	ALT. G	Alt. H
1	S	U	S	S	U	U	S	S
2	U	S	U	S	U	S	U	U
3	S	S	S	S	S	S	S	S
4	S	S	S	S	S	S	S	S
5	S	S	S	S	S	S	S	S
6	S	S	S	S	S	S	U	S
7	U	S	U	S	S	S	U	S
8	S	S	S	S	S	S	S	S
9	U	S	U	S	U	U	S	S
10	U	S	U	U	U	U	U	U
11	S	S	S	S	U	S	S	S
12	S	S	U	S	S	S	S	U
13	S	S	S	S	S	U	S	S
14	S	S	S	S	S	S	S	S
15	S	S	S	S	S	S	S	S
16	S	S	S	S	S	S	S	S
17	U	U	U	U	U	U	U	U
18	S	U	S	S	S	S	S	S
19	S	S	S	U	S	S	S	S
20	S	S	S	S	S	S	S	S

CRITERION 4 - MEETS MINIMUM NATIONAL FOREST WATER NEEDS
(Refer to page 5)

LAKE MARY

ITEM	NEEDS	Original Proposal ALT. A	No Project ALT. B	Lk.George Wells & Mary ALT. C	ALT. D	New Storage ALT. E	Outside Water ALT. F	MCWD Final Proposal ALT. G	Agency Combination ALT. H
VISUAL	Lake not raised. Drawdown no greater than 3' until Sept. 15th, never to exceed 5.7'. Lake to be full by June 1st.	U	S	U	S	S	S	U	S
RECREATION	Lake not raised. Drawdown never to exceed 5.7'. Lake full by June 1st.	U	S	U	S	S	S	U	S
WATER QUALITY	None	S	S	S	S	S	S	S	S
FISHERIES	None	S	S	S	S	S	S	S	S
VEGETATION	Drawdown no lower than 3' during growing season.	S	S	S	S	S	S	S	S
RIPARIAN WILDLIFE HABITAT	Drawdown no lower than 3' during growing season.	S	S	S	S	S	S	S	S
RANGE	None	S	S	S	S	S	S	S	S
TIMBER	None	S	S	S	S	S	S	S	S
		S / U = 6 / 2	S / U = 8 / 0	S / U = 6 / 2	S / U = 8 / 0	S / U = 8 / 0	S / U = 8 / 0	S / U = 6 / 2	S / U = 8 / 0

(22)

ICAL SUMMARY OF COMPARISON TABLES:

	Alternatives							
	Original Proposal	No Project	Lk.George & Mary Wells		New Storage	Outside Water	MCWD Final Proposal	Agency Combination
	ALT.A	ALT.B	ALT.C	ALT.D	ALT.E	ALT.F	ALT.G	ALT.H
	S / U	S / U	S / U	S / U	S / U	S / U	S / U	S / U
s w/Issues cerns t. 1)	15/5	17/3	14/6	17/3	14/6	15/5	15/5	16/4
ributing oal attain- (Crit.2)	8/2	9/1	5/5	9/1	4/6	3/7	6/4	10/0
t adverse ronmental cts t. 3)	10/7	14/3	11/6	16/1	9/8	7/10	14/3	17/0
s minimum eds t. 4)	65/14	75/5	65/15	75/5	68/12	75/5	57/23	80/0
TOTALS	98/29	115/12	95/32	117/10	95/32	100/27	92/35	123/4

ATIVE SUMMARY OF COMPARISON TABLES:

-NARRATIVE KEY TO NUMERICAL RATINGS-

	High	Moderate	Low	Lowest
s w/ Issues & Concerns t. 1)	17	15	14	
ributing to goal inment (Crit. 2)	10-9	8	6-5	4-3
st Adverse environmental ects (Crit. 3)	17-16	14	11-10	9-7
ts minimum NF needs it. 4)	80	75	68-65	57

nal Proposal ALT. A - Meets criteria 1 and 2 to a moderate degree, and criteria 3 and 4 to a low degree.

Project ALT. B - Meets criteria 1 and 2 to a high degree and criteria 3 and 4 to a moderate degree.

Appendix H. Decision

(Space available here to
place your examples.)

Appendix I. Monitor and Evaluate

(Space available here to
place your examples.)

Appendix J. Earth Scientist Imvolvement in TSPP

Presented at the Earth Science Symposium II by Gary Larsen

-- Issues and concerns are important. Push until they mean something to you!

-- Narrow your field of inquiry to one or a few factors of consideration! (Evaluation criteria - NEPA) (Planning criteria - NFMA)

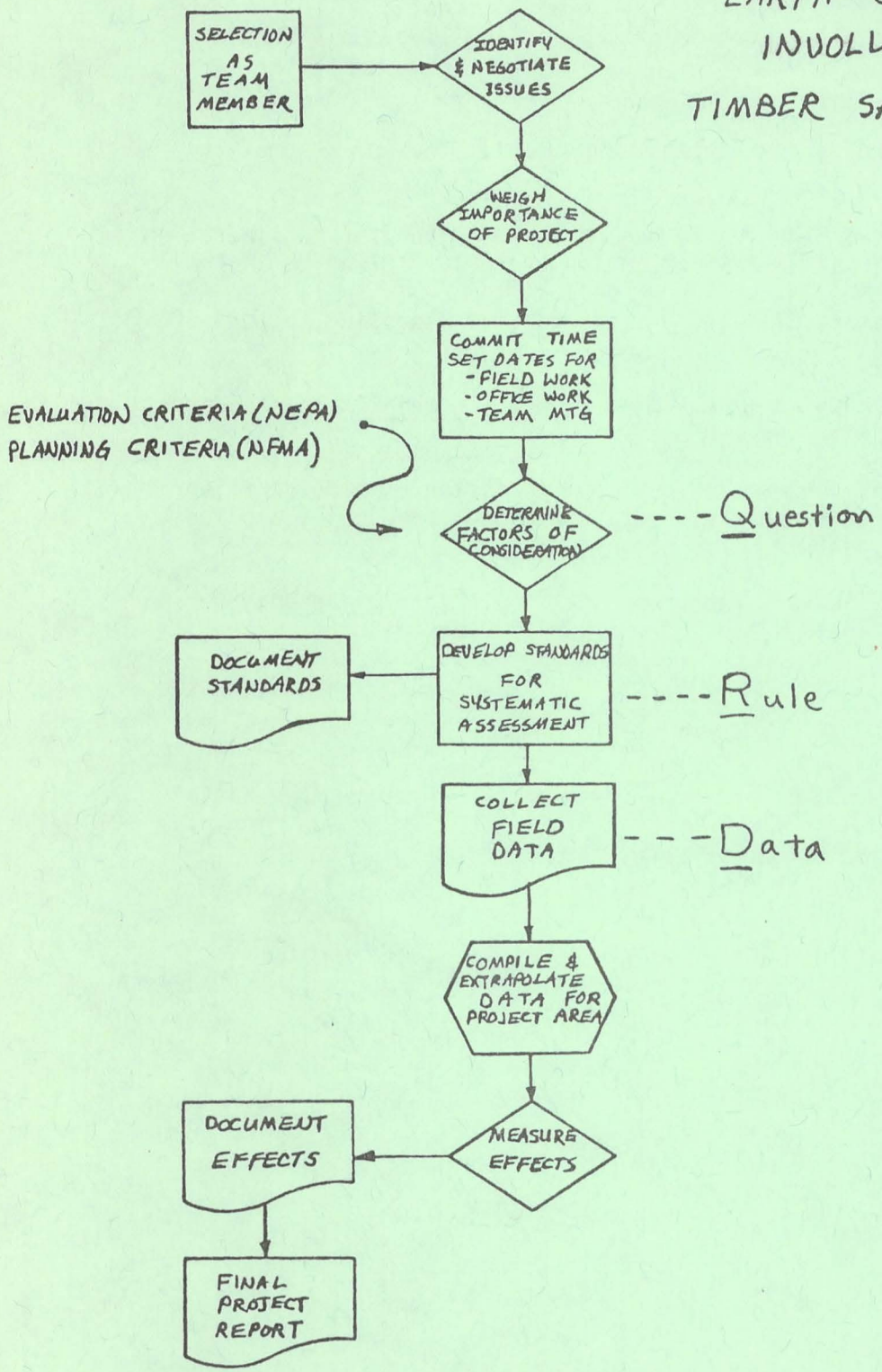
-- Develop and systematically apply standards for assessing factors of consideration!

-- Collect field data which is objective and which relates to standards!

-- Don't let time become your enemy and dilute your effort! It is better to have only one reasonably applied factor of consideration with well-developed standards than a score of sporadically applied subjective assessments.

-- Make your strategies for change and stick with them. The only person who makes no mistakes is the one who isn't doing anything.

EARTH SCIENTIST INVOLVEMENT TIMBER SALE PLANNING



G. Larsen

Appendix K
Stream Channel Stability - Evaluation Criteria
Stanislaus National Forest
1979

J. Frazier & E. Ruby

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Appendix K
Stream Channel Stability - Evaluation Criteria
Stanislaus National Forest

Purpose

These procedures were developed to systemize the evaluation of channels and establish evaluation criterian that can be used in the NEPA process. Each of 22 components are evaluated using a value of 1 to 4 to describe the sensitivity of that component to adjustments as a result of modifications made on the watershed. Mountain channels respond to every adjustment on their unique watershed by either aggrading or degrading. However, they can also recover to some extent, and this evaluation also includes their ability to recover from adverse impact.

Uses

The information may be gathered for a "point," for projects such as a bridge site or campground, or for a complete channel analysis for such things as fishery plans and timber sale. The end product is adaptable to the recently developed TSPP, to give the line officer a good evaluation of the response of the channel to his decision. Stream reaches, by order, and geologic types may be stratified and sampled to an intensity that meets the survey requirements to address issues, concerns, and opportunities in the NEPA process. Each reach of stream selected for evaluation should be relatively straight, and long enough to assess the sensitivity of each component to the existing conditions. The stream reach must "express" the functions of the stream.

Instructions

The field form has a brief description of what is required for each of the components to be considered within a given condition class. The detailed writeup and rationale for each condition class are contained in this field guide. Measurements are made in the field without much office work.

Amplification of the Channel Components

The channel cross section has been divided into three general components: the Channel, the Streamside Protection Zone, and the Sideslopes. All of these are interrelated, and function as a unit, but are segregated to amplify their importance to the total system.

DESCRIPTION OF CHANNEL COMPONENT CONDITIONS

I. STREAM CHANNEL

The channel is adequately described in the SPZ Guidelines as the area below the normal high waterline. Both aquatic and terrestrial vegetation may grow in the channel. The sides of the channel define the present stream width. Stability of these channel sides is indicated under a given flow by minor, almost imperceptable changes in channel width from year to year. In other words, encroachment of the water environment into the land environment is nil.

Under increased channel flow the sides may weaken and both cutting and deposition may begin. This is first seen at bends and points of constriction. Cutting is evidenced by steepening of the sides, and eventually the banks are undercut and slump in. As the channel is widened, it may also be deepened to accommodate the increased flow. The adjustments are due to changes that have been made in the watershed.

A. Channel Capacity

Channel width, depth, gradient, and roughness determine the volume of water which can be transmitted. Over time, channel capacity has adjusted to the size of watershed above the reach rated, climate, and changes of vegetation. Some indicators of change are widening and/or deepening of the channel which affects the ratio of width to depth. When the capacity is exceeded, deposits of soil are found on the banks and organic debris may be found hung up in the bank vegetation. These are expressions of the most recent flood event. Indicators of conditions as recent as a year or two ago may be difficult or impossible to find but do your best to estimate what normal peak flows are and whether the present cross section is adequate to handle the load without bank deterioration.

1. Excellent - Cross sectional area is ample for present peak volumes plus some additional, if needed. Over-bank floods are rare. Width to depth ratio less than 7.

2. Good - Adequate cross sectional area contains most peak flows. Width to depth ratio 8 to 15.

3. Fair - Channel barely contains the peak runoff in average years or less. Width to depth ratios range from 15 to 25.

4. Poor - Channel capacity generally inadequate. Over-bank floods quite common as indicated by kind and condition of the bank plants and the position and accumulation of debris. Width to depth ratio 25 or more.

B. Bank Resistance

Examination of the materials that make up the channel bank will reveal the relative resistance of this component to detachment by flow forces. Since the banks are perennially and intermittently both aquatic and terrestrial environments, these sites are harsh for most plants that make up both types. Vegetation is, therefore, generally lacking and it is the volume, size, and shape of the rock component which primarily determines the resistance to flow forces.

A soil pit need not be dug. Surface rock and exposed cut banks will enable you to categorize this item as listed by percentage ranges on the field form.

1. Excellent - Rock makes up 65 percent or more of the volume of the banks and within this rock matrix large, angular boulders 12 inches and larger in "diameter" are numerous.

2. Good - Banks 40-65 percent rock which are mostly small boulders and cobble ranging in size from 6-12 inches mean diameter. Some may be rounded while others are angular.

3. Fair - 20-40 percent of bank volume rock. While some big rock may be present, most fall into the 3-6 inch diameter class.

4. Poor - Less than 20 percent rock fragments, mostly of gravel sizes 1-3 inches in diameter.

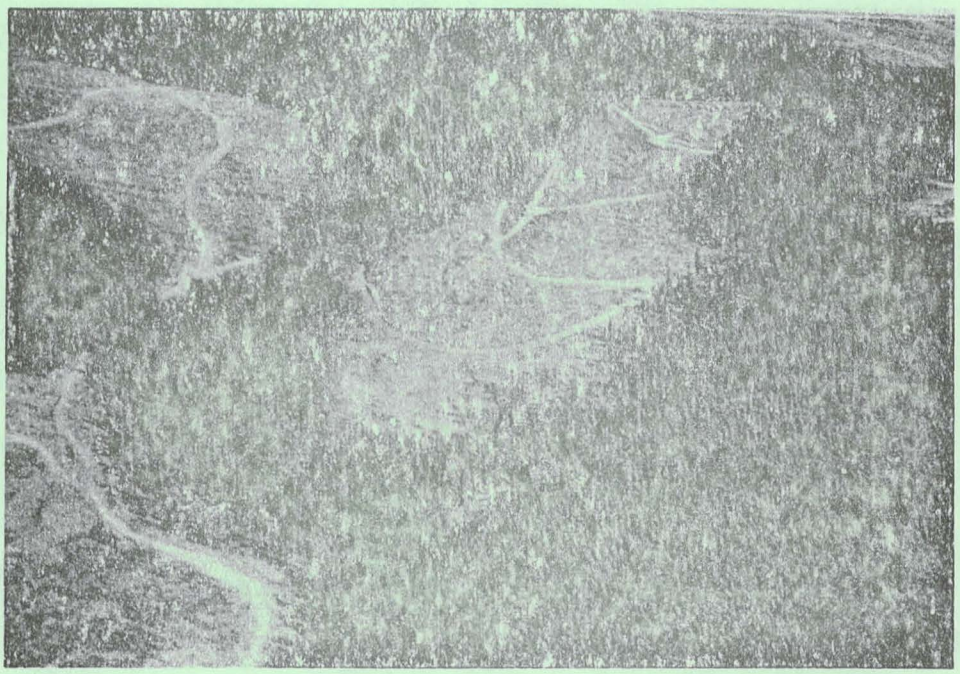
C. Obstructions and Flow Deflectors

Objects within the stream channel like large rocks, embedded logs, bridge pilings, etc., change the direction of flow and sometimes the velocity as well. Obstructions may produce adverse stability effects when they increase the velocity and deflect the flow into unstable and unprotected banks and across unstable bottom materials. They also may produce favorable impacts when velocity is decreased by turbulence and pools are formed.

Sediment Traps. Channel obstructions which dam the flow partly or wholly form pools or slack water areas. The pools lower the channel gradient. With this loss of energy the sediment transport power is greatly reduced. Coarse particles drop out first at the head of the pool while some or all of the fine suspended particles may carry on through.

Embedded logs and large boulders can produce very stable natural dams which do not add to channel instability. Some debris and beaver dams, however, are quite unstable and only serve to increase the severity of channel damage when they break up.

The volume and numbers of insect groups are good indicators of water quality, especially if the least tolerant species such as mayfly, caddis fly, and stone fly are present.



The uncut strip of timber along the stream provides shade, erosion barrier and insect drop for the fisheries resource.

Streams, like people, are a product of their environment. Here the aquatic environment has been changed over the years by man and nature's activities - such as roads, powerlines, wildfire, stream crossings. All interact to cause a braided, depositional, unstable section. This type of stream channel is highly sensitive to water yeild increases and produces detrimental changes in sediment production.

The effectiveness of these sediment traps depends on pool length relative to entrance velocity. The swifter the current, the longer the pool needed to reach zero velocity. Turbulence caused by falls at the head of the pool shortens the length required.

How long these traps are effective depends on depth and width as well as pool length and, of course, the rate of sediment accretion.

Items of vegetation growing in the water like alders, willows, cattails, reeds, and sedges are also effective traps in some locations. They too reduce flow velocity and sediment carrying power.

1. Excellent - Logs, rocks, and other obstructions to flow when present are firmly embedded and produce a pattern of flow which does not erode the banks and bottom or cause sediment buildups. Pool-riffle relationship stable.

2. Good - Obstructions to flow and sediment traps are present causing cross currents which cause some minor bank and bottom erosion. Some of the obstructions are newer, not firmly embedded, and move to new locations during high flows. Some sediment trapped in pools decreasing their capacity.

3. Fair - Moderately frequent and quite often unstable obstructions causing noticeable seasonal erosion of the channel. Considerable sediment accumulates behind obstructions.

4. Poor - Obstructions and traps so frequent they are intervisible, often unstable to movement and causing a continual shift of sediments at all seasons. Since traps are filled as soon as formed, the channel migrates and widens.

Cutting and Deposition are concommitment processes. You cannot have one without the other. However, it is possible for each to be taking place in different reaches of the same stream at the same time and, hence, the separation for classification purposes which follows.

D. Cutting

One of the first signs of channel degradation would be a loss of aquatic vegetation by scouring or uprooting. Some channels are naturally devoid of aquatic plants and here the first stages would be an increase in the steepness of the channel sides. Beginning near the top, and later extending in serious cases to the total depth, the channel side becomes a near vertical wall.

If plant roots bind the surface horizon of the adjacent bank into a cohesive mass, undercutting will follow. This process continues until the weight of overhang causes the sod to crack and subsequently slump into the channel. Differential horizontal compaction and texture could also result in undercut banks even with an absence of vegetative cover. Lastly, there are some loosely consolidated banks that with or without vegetation are literally nibbled away, never developing much, if any, overhang.

1. Excellent - Very little or no cutting is evident. Raw, eroding banks are infrequent, short and predominately less than 6 inches high.

2. Good - Some intermittent cutting along channel outcurves and at prominent constrictions. Eroded areas are equivalent in length to one channel width or less and the vertical cuts are predominately less than 12 inches.

3. Fair - Significant bank cutting occurs quite frequently in the reach. Raw vertical banks 12 to 24 inches high are prevalent as are root mat overhangs and sloughing.

4. Poor - Nearly continuous bank cutting. Some reaches have vertical cut faces over 2 feet high. Undercutting, sod-root overhangs, and vertical side failures may also be frequent in the rated reach.

E. Deposition

Channel sides of the lower bank area are the steeper portions of the wetted perimeter and may be rather narrow strips of land that offer slight opportunity for deposition. Exceptions to this statement abound since deposition is often noted on the lee side of large rocks and log deflectors which form natural jetties. On the less steep lower banks, deposition during recession from peak flows can be quite large. The appearance of sand and gravel bars where they did not previously exist may be one of the first signs of upstream erosion. These bars tend to grow with continued watershed disturbance(s) in depth and length primarily. Width changes are in a shoreward direction as overflow deposition on the upper banks takes place. Dimensional "growth" is limited by the size and orientation of the obstructions to flow along the channel sides, flow velocity, and a continuing upstream sediment supply.

Deposition may also occur on the inside radii of bends, particularly if active cutting is taking place on the opposite shore. Also, deposits are found below constrictions or where there is a sudden flattening of stream gradient as occurs upstream above geologic nic points.

This stream section demonstrates many of the characteristics of good streambank and channel bottom stability -- such as moss covered angular rocks, sloped and vegetated streambanks, lack of scouring and deposition.

Sediment deposition in this low gradient stream section of Rye Creek is an indicator of major disruptive forces in the upper watershed.

1. Excellent - Very little or no deposition of fresh silt, sand or gravel in channel bars in straight reaches or point bars on the inside banks of curved reaches.

2. Good - Some fresh deposits on bars and behind obstructions. Sizes tend to be predominated from the larger size classes--coarse gravels.

3. Fair - Deposits of fresh, coarse sands and gravels observed with moderate frequency. Bars are enlarging and pools are filling so riffle areas predominate.

4. Poor - Extensive deposits of predominately fresh, fine sands, some silts, and small gravels. Accelerated bar development common. Storage areas are now full and sediments are moving even during low flow periods.

F. Bottom Strata Scour Indicators

Water flows over the channel bottom nearly all of the time in perennial streams. It is, therefore, almost totally an aquatic environment composed of inorganic rock constituents found in an infinite variety of kinds, shapes, and sizes. It is equally a complex biological community of plant and animal life. This latter component is more difficult to discern and may in fact, at certain times and places, be totally lacking.

Both components by their appearance alone and in combination offer clues to the stability of the stream bottom. They are arbitrarily separated and individually rated for convenience and emphasis only during the evaluation process. The work is best accomplished during the low flow season and when the water is free of suspended or dissolved substances because of the high reliance on the visual sense. If ratings must be made in high flow periods, sounds of movement may be the only clue as to the state of flux on the bottom.

1. Angularity. Rocks from stratified, metamorphic formations break out and work their way into channels as angular fragments that resist tumbling. Their sharp corners and edges wear and are rounded in time, but they resist the tumbling motion. These angular rocks pack together well and may orient themselves like shingles (imbricated). In this configuration they are quite resistant to detachment.

   In contrast, igneous rocks often produce fragments that round up quickly, pack poorly and are easily detached and moved downstream.

a. Excellent to Poor ratings relate to the amount of rounding exhibited and secondarily to the smoothness or polish the surfaces have achieved. Some rocks never do smooth up in the natural environment, but most round up in time. Both conditions, of course, are relative within the inherent capability of the respective rock types.

2. Brightness. Rocks in motion "gather no moss," algae or stain either. They become polished by frequent tumbling and, as a general rule, appear brighter in their chroma values than similar rocks which have remained stationary. The degree of staining and vegetative growths relates also to water temperature, seasons, nutrient levels, etc. In some areas a "bright" rock will be "dulled" in a matter of weeks or months. In another it may take years to achieve the same results. Nevertheless, even slight changes during the spring runoff should be detected during the next summer's survey. Look first for changes in the sands and gravels.

   a. Excellent - Less than 5 percent of the total bottom would be bright, newly polished and exposed surfaces. Most will be covered by growths or a film of organic stain. Stains may also be from dissolved water minerals.

   b. Good - 5 to 35 percent of the bottom appears brighter, some of which may be on the larger rock sizes.

   c. Fair - About a 50-50 mixture of bright and dull with a 15+ percent leeway in either direction (i.e., a range of from 35 to 65 percent bright materials).

   d. Poor - Bright, freshly exposed rock surfaces predominate with two-thirds or more of the bottom materials in motion recently.

3. Consolidation (Particle Packing). Under stable conditions, the array of rock and soil particles sizes pack together. Voids are filled and the larger components tend to overlap like shingles (imbrication) over the similar sizes. So arranged, the bottom is quite resistant to even exceptional flow forces. Some rock types (granitics) are less amenable to this packing process and never reach the stable state of others like the Belt Series rocks.

   a. Excellent - An array of sizes are tightly packed and wedged with much overlapping which makes it difficult to dislodge by kicking.

   b. Good - Moderately tight packing of particles with fast water parts of the cross section protected by overlapping rocks. These might be dislodged by higher than average flow conditions, however.

c. Fair - Moderately loose without any pattern of overlapping. Most elements might be moved by average high flow conditions.

d. Poor - Rocks in loose array, moved easily by less than high flow conditions, and move underfoot while walking across the channel bottom. The shape of these rocks tends to be predominantly round and sorted so that most are of similar size.

4. Clinging Aquatic Vegetation. When the channel bottom components become stabilized, the soil/rock mix becomes fit habitat for plant and animal life. This process begins in the slack water areas and eventually may include the swift water portions of the stream cross section. With a change in volume of flow, and/or sedimentation rates, there may also be a temporary loss of the living elements in the aquatic environment. Clinging moss and algae are good indicators that express a change in channel stability.

These lower plant forms do not have roots, but cling to the substrate. They are low growing and may first appear as a green to yellow-green slick spot on the bottom rocks. Moss plants continue from season to season, with slight variations in color, but no great change in mass. Algae, by contrast, have a peak of growth activity and then die off in great numbers.

Both algae and moss inhabit the swift water areas as well as the quiet pools and backwater areas of the stream bottom.

a. Excellent - Clinging plants are abundant throughout the reach from bank to bank. A continuous mat of vegetation is not required, but moss and algae are readily seen in all directions all across the stream.

b. Good - Plants are common in the slow water areas, but thin out or are completely absent in the swift flowing areas of the stream.

c. Fair - Plants are found, but their occurrence is spotty. They are almost totally lacking in swifter flowing areas, and may also be absent in some of the slow and still waters.

d. Poor - Clinging plants are rarely found anywhere in the reach. This may be an unusual situation, and would typically follow a severe channel scour event, or sedimentation of the substrate.

G. Bottom Size Distribution and Percent Stable Materials

Rocks remaining on a stream's bottom reflect the geologic sources within the basin and the flow forces of the past. Normally, there is an array of sizes that you expect to see in any given locale. After a little experience, you begin to "sense" abnormal situations. Generally, in the mature topography typical of the Stanislaus National Forest watersheds, and much of the other western Regions as well, the flow in the small, steep upper stream reaches is sufficient to wash the soil separates and some of the gravels away. What remains is a gravelly, cobbly stream bottom. In the lower reaches where the gradient is less and flow is often slower, deposition of the "fines" eroded above begin to drop out. The separates of sand, silt, and some clay begin to cover the coarser elements. Except where trapped in still water areas, these fines tend to be in constant motion to even lower elevations.

Two elements of bottom stability are rated in this item: (1) changes or shifts from the natural variation of component size classes, and (2) the percentage of all components which are judged to be stable materials. Bedrock, large boulders, and cobble stones ranging in size from one to three feet or more in diameter are considered "stable" elements in the average situation. Obviously, smaller rocks in smaller channels might also be classed as stable. The sizes given are to guide thought only. Bedrock as a major component of bottom and banks, no matter what size the channel or how the other elements rate, always results in an excellent classification of that reach.

1. Excellent - There is no noticeable change in size distribution. The rock mixture appears to be normal for the kind of geologic sources in the basin and the flow forces of streams of this size and location in the watershed. Stable materials 80-100 percent.

   If a shift or change has taken place so there are greater percentages of large rock in the small streams and smaller sizes in large streams, the condition class most appropriate should be checked. It is a matter of degree as follows:

2. Good - Slight shift in either direction, 50-80% stable.

3. Fair - Moderate shift in size classes, 20-50% stable.

4. Poor - Marked, pronounced shift, less than 20% stable.

H. Bedload Unloading Phase

The natural process of channels is to accumulate sediments as a result of any one of several factors:

- Encroachment of riparian species that stabilize the sediments as they accumulate.
- Agrading of the next higher order channel, which induces sediment deposits in tributary channels.
- Debris jams and subsequent vegetal stabilization.
- Catastrophic events (e.g., fire) that yield large volumes of sediments, with subsequent vegetal stabilization.
- Long time accumulations of minor amounts of sediments, which are simultaneously stabilized by dry site species.

Sometimes sediments accumulate so deep that they assume an unstable angle of repose, then naturally gully out. This is geologic erosion. Note in each of the above cases the sediments in the channels must be held in place by vegetal cover, or they will not accumulate. All channels will eventually unload their sediments, but it may be several hundred years between unload events. The channel bedload, if left undisturbed for long periods, may become extremely stable, especially in the upper reaches.

When the stabilizing agent, normally vegetal roots, are caused to deteriorate, or are removed, then the sediments are made available for transport. Usually some adjustment must be made in the watershed to initiate the unload phase. For example:

- Fire may destroy the soil cover and create hydrophobic soils.
- Resource activity may destroy the soil cover or root mass.
- Runoff may be collected and concentrated by a road, skid trail, culvert pipe, cow trail, people trail, etc., then directed into a channel.
- Runoff from other watersheds may be diverted into a loaded channel by a road ditch, terrace, or other means.

When the channel begins to gully out, due to some adjustment in the watershed, it is called accelerated erosion.

The first indication of an unload phase may be a headcut, a series of steps held by roots, a small gully, or scoured out places in the bedload. The process can sometimes be halted or reversed by discovering the cause of the problem and treating it.

Using the items of angularity, brightness, etc., already rated above, it should be possible to rate the unload potential.

1. Excellent - No evidence of recent unloading, bedload stable with vegetal cover. Neither scouring nor deposition is over 5 percent of the channel reach (i.e., 5 ft./100 ft.).

2. Good - Recent gully activity could be stopped with good resource management. Affected lengths range up to 30 percent of the reach. Cuts and scours are mostly on channel constrictions, or at pitches in the gradient.

3. Fair - Advanced gullies are present. Scour and cutting on 30-50 percent of the channel, with bottom in a state of flux. Channel will continue to unload until a stable level is reached, or major treatment is done.

4. Poor - Channel unloaded, or nearly so; side banks are now adjusting to a new angle of repose relative to the new channel level. Over 50 percent of channel shows cutting and scour.

II. STREAMSIDE PROTECTION ZONES

A. Slope of the SPZ

On the Stanislaus, the critical slope seems to be about 30%. Up to this percent slope, the sensitivity of the soils seems to be about equal. Slopes greater than this tend to be more erodible for all soils. As the slope increases, sensitivity seems to increase geometrically. The steeper the slope of the SPZ, the more harm can be done by overdisturbance.

1. Excellent - Slopes less than 15 percent on both banks.

2. Good - Slopes 16-30 percent on one or both banks.

3. Fair - Slopes 30-50 percent on one or both banks.

4. Poor - Slopes greater than 50 percent common on both banks.

B. Flood History Indicators

Since channels are the end product of all the functions of a watershed, it should be the first place where the violence of historic floods can be estimated. Some indicators of violent flood flows are:

- Lack of pole/sawlog size trees in the channel. The trees are regularly scoured out by floods. The floods occur frequently because of some character of the watershed.
- A corridor, or cave-like appearance to the trees adjacent to the channel. Floods have removed the limbs next to the channel.
- Scars on tree trunks where rocks have removed bark.
- Large boulders and no fine sediments.
- Bedload shiney from frequent turn over.

The opposite would indicate stable channels.

1. Excellent - Pole and sawlog size trees occur regularly in the channel, at or near waters edge. No obvious corridor or scarred trees. Bottom strata include variety of sizes.

2. Good - Poles and sawlog sizes occur in channel. May be a recent corridor formed on certain age classes, but not all ages, indicating a high magnitude flood. Bedload includes all sizes.

3. Fair - Definite corridor is obvious, most age classes of trees. Large rocks, up to 16 inches diameter, with a shortage of finer materials.

4. Poor - Regular flooding evident by scars on trees, limbs missing, lack of poles and larger trees in channel. Large boulders, with some cobbles, but very little fine materials. Boulder size may be on bedrock that is exposed in places.

C. Character of Streamside Protection Zone

The type of watershed protection on the SPZ is the key to maintaining a stable buffer for the stream. Some function of the SPZ are to filter out sediment from overland flow, protect the floodplain in high magnitude floods, provide shade for the aquatic environment, and protect the sensitive alluvial soils. If the SPZ has an inherent stability (such as bear clover) and would be stable without trees, then it can be clear cut without creating a watershed problem. Bear clover is the best watershed plant on the Stanislaus because it collects leaf fall, can tolerate the shade of understory conditions, sprouts after fire, and a variety of other reasons. Where dense bear clover exists, it stabilizes the site, and removing the trees will not degrade the site; but post-harvest activity can degrade the site. Therefore, the goal of reforestation and other activity should recognize the value of this inherent stability and remove only enough of it to permit trees to grow. This section of channel evaluation is based on bear clover, but any other plant that meets the same standards can also be considered.

1. Excellent - Stand density covers at least 65 percent of the soil surface, on 90 percent of the SPZ. Plants have accumulated leaf litter and organic debris 3 inches deep. Practically no overland flow of water is evident. Plants grow down to the stream channel high water mark.

2. Good - Stand density covers at least 35 percent of the soil surface on 50 percent of the SPZ, with adequate litter accumulation. Soils are essentially stable, and plants grow down to high water mark with enough continuity to provide a root mass.

3. Fair - Stand density less than 35 percent, but existing. May or may not have leaf litter accumulation, and plants may not extend to the high water mark. Root mass discontinuous, interspace between plants is often void of litter or ground plants.

4. Poor - No bear clover, or less than 10 percent density. Lack of bear clover or other ground vegetation makes the channel sensitive if the overstory is removed. Total live plant cover plus litter is less than 65 percent in many cases.

D. Vegetal Bank Stabilization by Riparian Species

The soil in channel banks is held in place largely by plant roots. Riparian plants have almost unlimited water for both crown and root development. Their root masses generally increase in density with proximity to the open channel. Trees and shrubs generally have deeper root systems than grasses and forbs. Roots seldom extend far into the water table, however, and near the shore of lakes and streams they may be comparatively shallow rooted. Some species are, therefore, subject to windthrow.

In addition to the benefits of the root mass in stabilizing the banks, the stems help to reduce the velocity of flood flows. The seriousness of laminar flow, due to turbulence from the stems, depends on the density of both overstory and understory vegetation. The greater the density, the more resistance. Damage from turbulence is greatest at the periphery and diminishes with distance from the normal channel. Other factors to consider in addition to the density of stems are variety of vegetation, vigor and growth, and reproduction processes. Vegetal variety is more desirable than monotypic plant community. Young plants, growing and reproducing vigorously, are better than old, decadent stands.

1. Excellent - Trees, shrubs, grasses, and forbs combined cover over 90 percent of the ground. Openings are small and evenly dispersed. A variety of species and age classes are represented. Growth is vigorous, reproduction of species is adequate. A deep, dense root mass is inferred.

2. Good - Plants cover 70-90 percent of ground. Shrub species are more prevalent than trees. Openings larger than space resulting from loss of a single, mature tree. While growth vigor may be good, reproduction may be sparse, advanced reproduction may be lacking. The deep root mass is not continuous.

3. Fair - Plant cover ranges from 50-70 percent. Lack of vigor is evident in some individuals and/or species. Seedling reproduction is nil. Root mass not continuous nor deep.

4. Poor - Less than 50 percent of the ground is covered. Trees are essentially absent. Shrubs in scattered clumps, growth and reproduction vigor is poor. Poor, shallow root masses.

E. Resistance to Flooding

This is an estimate of the barriers in the channel that will resist the flow of flood waters. Obstructions such as tree trunks, rocks, underbrush, exposed tree roots, and roughness all resist flow, while such things as moss, grass, clays, etc., tend to increase the flow. In general, the more resistant the floodplain, the less velocity to the flood flow, and the less damage can be done.

1. Excellent - Dense trees, less than 6 feet apart, flat floodplain, with banks well vegetated and stable, no disturbance of the soil. Can also be large rocks, over 3 cu. yds./rock, with angular corners, close enough together to obstruct the flow.

2. Good - Streambank disturbed, but less than 30 percent, and stable. Tree trunks, or rocks 6 feet to 15 feet apart, on a floodplain that slopes less than 15 percent.

3. Fair - Streambank disturbed over 50 percent, and unstable, with trees and rocks 15 feet and over apart, lack of underbrush and other stabilizers. Grass may be present, or short vegetation that will lay flat in a flood.

4. Poor - Streambank and floodplain disturbed over 70 percent, with few or no trees and rocks or underbrush to slow the flow. May have exposed clay or silty soil along channel, or rounded sands and gravels.

F. Debris Jam Potential

Floatable objects are deposited on streambanks by man and as a natural process of forest ecology. By far the bulk of this debris is natural in origin. Tree trunks, limbs, twigs, and leaves that reach the channel make up the bulk of the obstructions, flow deflectors, and sediment traps to be rated below. This item attempts to assess the potential for increasing these impediments to the natural direction and force of flow where they now lay. It also alludes to the possibility for creating new debris jams under certain flow conditions.

1. Excellent - Debris may be present on the banks, but is so situated or is of such size that the stream being rated is not able to transport it into the channel and, for all intents and purposes, it is absent. In truth, there may be none physically present. Both situations are rated the same.

2. Good - The debris present offers some bank protection for awhile, but is small enough to be floated away in time. Only small jams could be formed with this material alone.

3. Fair - There is a noticeable accumulation of all sizes and the stream is large enough to transport it, thus decreasing the bank protection afforded while located on the banks and adding to the debris jam potential downstream.

4. Poor - Moderate to heavy accumulations are present due to fires, insect attack, disease mortality, windthrow, or logging slash. High flows will transport debris from tributary channels, causing debris jams and deflectors.

III. SIDESLOPES DIRECT TO THE CHANNEL

A. Slope Percent

The land area immediately adjacent to the stream channel is typically a terrestrial environment. Landforms vary all the way from wide flat alluvial plains to the narrow steep termini of mountain slopes. Intermittently this dry land floodplain becomes a part of the water course. Forces of velocity and turbulence tear at the vegetation and land, and wear them away to form the canyons in which the channels flow. These hydrologic forces, while relatively short-lived, have great potential for producing on-site enlargements of the stream channel, and downstream sedimentation. Resistance of the channel components to wear is indicated by the slope of the sidehill that leads directly to the channel, because this influences the velocity of the tributary flows.

The steepness of the land adjacent to any channel determines the lateral extent and ease to which banks can be eroded and the potential volume of material that can enter the water. The steeper the land, the greater the volume of materials, all other factors being equal. The 60 percent limit for poor was selected as a conservative gravitational repose angle for unconsolidated materials. Slopes that are steeper than this are rated poor because they would erode by gravity alone if denuded of protective vegetation. The other ratings are built relative to this limit.

1. Excellent - Sideslopes to the channel are generally less than 30 percent on both banks, or there is a flat floodplain, as wide as the slope is long, to dissipate the flow.

2. Good - Sideslopes up to 40 percent on one or both banks.

3. Fair - Sideslopes up to 60 percent on one or both banks.

4. Poor - Steep slopes, over 60 percent, provide larger volumes of soil material per increment of lateral bank cutting.

B. Slope Length

The slopes that lead direct to the channel can influence the magnitude of the peak flow, and the destructive potential. The longer the slope, the greater the hazard from excessive velocities, and build-up of hydrologic head. These types of slopes are usually those that have incised channels, common to mountain terrain, and need to be distinguished from the slopes that are remote from the channel. The remote slopes yield water to a lesser order channel, and do not contribute directly to the main stem.

1. Excellent - Slopes less than 100 feet.

2. Good - Slopes 100 to 300 feet.

3. Fair - Slopes 300 to 1000 feet.

4. Poor - Slopes over 1000 feet long.

C. Mass Wasting Hazard

This rating concerns the existing or potential detachment of the soil mantle and downslope movement into waterways of relatively large pieces of ground. Mass movement of banks by slumping or sliding introduce large volumes of soil and debris into channels suddenly, causing constrictions or complete daming. This in turn increases streamflow velocities, cutting power, and sedimentation rates until the material wears away. Conditions deteriorate in this element with proximity, frequency, and size of the mass wasting areas.

1. Excellent - There is no evidence of mass wasting that has or could reach the stream channel *en masse*.

2. Good - There is evidence of infrequent and/or very small slumps. Those that exist may occasionally be "raw," but predominately the areas are revegetated and stable.

3. Fair - Frequency and/or magnitude of the mass wasting situation increases to the point where normal high water aggravates the problem of channel changes and subsequent undercutting of unstable areas with increased sedimentation.

4. Poor - Mass wasting is not difficult to detect, due to frequency and size of existing problem areas. Increases in flow can cut the toe of the slides and trigger further movement of the slide.

D. Gully Potential of Sideslope

Some sideslopes are stabilized by aggressive ground vegetation like bear clover, and others are almost bare of cover. The gully potential is related to the steepness and length of the slope, as well as the resistance of the soils to detachment. This element is a measure of the results of discharging concentrated runoff on the soils.

1. Excellent - No gullies or rills apparent in the soils, clay content of soil resists wear, no dry ravel. The "B" horizon is a clay derivative. Soil cover adequate, and plant roots bind the soil in place.

STREAM CHANNEL STABILITY - EVALUATION CRITERIA

Stanislaus National Forest - 1979

STREAM SURVEY Date:---/---/---; Time:-------Hrs. TOTAL SCORE:------- RATING:----------

Observer:----------; Ranger District:_____; Project: ----------; Water Uses: ----------

STREAM REACH Location:_____; Elev.:_____msl; Length:_____; Width:_____; Depth:_____; Gradient:____

Value Class:_____; Fishery?_____; Flow @ Present:____; Geology:_____; Veg.Zone:_____; Remarks:_____

Character of bottom:_____; Name of Creek:_____; Order:_____;

(3 Predom.Components) Thence,_____

* * * STABILITY INDICATORS BY ELEMENT CONDITION CLASSES * * *

ITEM RATED	EXCELLENT		GOOD		FAIR		POOR	
I. STREAM CHANNEL								
A. Channel Capacity	Ample for present + some increases. Peak flow contained without bank cutting, or scour indicators.	1	Adequate, X-Section area contains most peak flows with little or no bank cutting. Some scour.	2	Rarely contains present peak flows, some bank cutting apparent, but not accelerated.	3	Inadequate, significant bank cutting in progress now, and is accelerating.	4
B. Bank Resistance to wear	65% rock with large angular boulders 12"+ in diameter, and numerous.	1	40%-65% rock, mostly small boulders, to cobble 6" to 12" in size.	2	20%-40% rock, mostly 3" to 6" diameter class.	3	Less than 20% rock in the exposed banks, and these may be gravel sizes in lenses with silts.	4
C. Flow Deflection	Rocks, old logs firmly embedded, flow patterns of pools & riffles stable without cutting or deposits.	1	Some present, causing erosive cross currents, & minor pool filling. Obstructions & deflectors newer and less firm.	2	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	3	Frequent obstructions, and deflectors cause bank erosion yearlong. Sediment traps full, channel migration apparent.	4
D. Cutting	Little or none evident. Infrequent raw banks less than 6 inches high.	1	Some, intermittently at outcurves & constrictions. Some soil slumps.	2	Significant cutting, with frequent root mass overhang and sloughing of banks.	3	Relatively continuous cutting of banks and downcutting of channel W/failure of overhangs frequent.	4
E. Deposition	Little or no enlargement of channel sand bars, or point bars.	1	Some increase in sediment bar formation, mostly of coarse gravels.	2	Moderate deposition of new gravel & coarse sand on old bars, W/ some new bars.	3	Extensive deposits, up to 3 sand bars/$\frac{1}{4}$ Mile, of predominantly fine sediments that tend to seal strata.	4
F. Bottom Strata Scour indicators	1. Angularity-Sharp edges and corners, W/plane surfaces roughened.	1	Rounded edges & corners, plane surfaces smooth but not polished.	2	Well rounded edges & corners in two dimensions, W/smooth plane surfaces & some polish.	3	Well rounded, edges and corners not apparent, smooth or polished plane surfaces. Frequent spheres.	4
	2. Brightness-Surfaces dull, darkened, or stained. Generally not bright.	1	Mostly dull, but may have up to 30% bright surfaces on rocks.	2	Mixture of 50%/50% dull and bright, with some evidence of recent turning over.	3	Predominantly bright surfaces, 65%+ exposed or scoured surfaces. Recent turn over evident, no dull left.	4
	3. Consolidation-particle packing tight, & wedged W/ much overlap and assorted sizes. Solid walking tred.	1	Moderately tight packing W/some overlapping, but do not move from walking except for minor amount.	2	Mostly a loose assortment of strata with no overlap that will move when walked on. Average high flow will move.	3	No packing evident, loose array, of strata that moves when walked on so that walking is difficult. Mostly one size class.	4
	4. Clinging aquatic Vegetation abundant, moss like dark green, perennial.	1	Common, algae forms in low velocity and pool areas, moss like.	2	Present, but spotty, mostly in backwater areas, or above disturbed areas. Remnants.	3	Perennial types scarce, or absent due to channel scour &/or sedimentation. No Remnants evident.	4
G. Bottom Size Distribution	Stable material 100%-80%. Good size distribution from sand to cobbles.	1	Stable Material 50%-80%. Some fines have been removed, gravels exposed.	2	Stable Material 20%-50%. Fines and gravels have removed, coarse residual.	3	Stable Material 1%-20%. Larger fragments are predominant with few smaller sizes.	4
H. Bedload unloading	No evidence of unloading or head-cutting. Stable bedload W/ trees & veg.	1	Recent headcut & gully activity, but can be stopped or reversed with management	2	Advanced gully activity and scour on 30%-50% of the channel reach is affected.	3	Channel unloaded, or nearly so. Sidebanks assuming a new angle of repose. No bedload remnants.	4

2. Good - Old gullies apparent, but healed over. Gullies could be reactivated. Some clay in soil, no dry ravel. Soils can be granitic or volcanic in origin.

3. Fair - Old gullies present and still active. Moderate dry ravel may be present, and small talus cones may be forming. Usually a decomposing granitic soil, without cohesiveness.

4. Poor - Decomposing granitic, loose, uncohesive soils, severe dry ravel present. Less than adequate soil cover, few fine roots, gullies raw and active. Walking on soil displaces it.

E. Character of Ground Vegetation

The type of soil cover on the sideslope is the key to maintaining a stable slope, and controlling the runoff to the channel below. If the sideslope has an inherent stability, such as bear clover, or other vigorous ground plant, then the trees can be removed, or other disturbances can be done, without degrading the channel. This means that the amount of a sideslope that can be clear-cut without adversely affecting the channel is directly related to the amount of flow retarding vegetation on the soil.

1. Excellent - Stand density of bear clover or other vigorous plant is at least 65 percent on 90 percent of the slope. Plants have accumulated enough leaf litter to retard runoff. Almost no evidence of overland flow.

2. Good - Stand density is at least 35 percent of the soil surface on 50 percent of the area, with adequate litter accumulation. Soils are essentially stable, with a vigorous root mass.

3. Fair - Stand density may be less than 35 percent, or leaf litter of at least 4 inches thick, but one or the other is existing. Bare areas between soil cover small, less than 10 feet in diameter.

4. Poor - No bear clover, or less than 10 percent density, and no other ground plant capable of restabilizing the site. When the overstory is removed the site is devoid of cover to protect it for very long. There may be litter, but it will be destroyed in resource activity.

II. STREAMSIDE PROTECTION ZONES								
A. Slope of the SPZ	Slopes less than 15% on both banks.	1	Slopes 16%-30%, on one or both banks.	2	Slopes 30%-50% on one or both banks.	3	Slopes greater than 50% common on both banks.	4
B. Flood History of SPZ	Pole and sawlog trees numerous, uniform mix W/no corridors.	1	Poles & sawlog trees present with good mix; no age class unique to channel.	2	Definite corridor obvious along channel. Large rocks 16" dia.+, W/lack of fines.	3	Definite corridor and marks of regular flooding are scars on trees, lack of fines, debris in channel.	4
C. Character of SPZ	Riparian veg species in uniform density of 65% to 90%; healthy root mass W/ leaf litter 3" deep.	1	Plant density 35%-65% W/ adequate litter on over $\frac{1}{2}$ of SPZ; repro. sparse & deep root mass discontin.	2	Plant density less than 35% but present; interspace often bare, or light litter. Root mass shallow, or sparse.	3	Plants largely lacking, no bear clover or other dense plant cover. Less than 65% ground cover density and some tree roots exposed.	4
D. Vegetal bank Stabilization	Soil in banks held by plant roots, includes ground plants W/ litter stable angle of repose.	1	Plants and litter cover the sidebanks, W/stable interspace between plants. No obvious damage from floods.	2	Plants on sidebanks low vigor W/ bare interspace. Banks are still sloughing, w/obvious flood scour. Root mass slight.	3	Less than 50% of the ground is covered; trees essentially absent, growth and repro vigor is poor W/no continuous root mass.	4
E. Resistance to Flooding	Dense trees, or vegetal cover to retard flow well enough to decrease veloc.	1	Disturbed 30%, trees on wide spacing, but will retard flow & prevent scour.	2	Disturbed over 50% W/trees & rocks ineffective in retarding flow, scour obvious.	3	Flood plain disturbed over 70% W/ few or no trees or other barriers to flow. Exposed scour marks.	4
F. Debris Jam Potential	Debris present, but stream unable to transport, or none presently in transport by water.	1	Debris present, & small enough to be moved by hi-magnitude floods. Only small jams possible	2	Debris present & accumulations of all sizes & stream is transporting or forming debris jams now.	3	Moderate to heavy concentrations due to resource mgmt. activity or fire. High or moderate flow will cause debris jams.	4
III. SIDESLOPES DIRECT TO THE CHANNEL								
A. Slope Percent	Sideslopes less than 30% on one side only.	1	Sideslopes 30%-40% on both banks, or one bank.	2	Sideslopes 60% on one or both banks.	3	Sideslopes greater than 60% on both banks.	4
B. Slope Length	Length = less than 100 ft	1	Length= 100-300 feet	2	Length=300-1000 feet	3	Length = over 1,000 feet	4
C. Mass Wasting	No evidence either past, or present; trees straight boled, no benches.	1	Infrequent evidence, or small, or healed over. less than 50 cu.yd.each.	2	Normal high water will transport materials to stream & cause sedimentation;100CY	3	Obvious slipes and slides, such that any increase in flows will aggravate; over 100 cu.yd.each.	4
D. Gully Potential of side slopes.	No gullys or rills, clay in soils help to bind in place. Resistent to wear.	1	Old gullys may be present, but healed over, no dry ravel, clay in soils.	2	Old gullys present & still active, some dry ravel but not obvious; soil loose.	3	Active gullies, dry ravel, or rill present. Soils uncohesive, and dry and harsh site for vegetal cover.	4
E. Character of ground veg.	GCD includes 30% plants and 35% other cover; no evidence of overland flow.	1	GCD includes 20% plant on of the area w/45% other soil cover, runoff slight	2	GCD includes less than 10% of area with 50% leaf litter 3" deep; runoff obvious.	3	Few plants in the ground cover components, mostly litter, runoff pattern formed in the soils.	4

BOTTOM STRATA COMPONENTS:
1. Solid Bedrock
2. Large Boulders(1+ cu.yd.)
3. Small Boulders(1- cu.yd.)
4. Cobbles (3in. to 10 in.)
5. Gravels (Sand to 3" dia)
6. Sand (0.05 mm to 2 mm)
7. Silt & Clay (0.05 mm)

WATER USES COMPONENTS:
1. Domestic
2. Fish Culture
3. Recreation
4. Special Uses
5. Water Sports

EVALUATION CRITERIA

Excellent Condition	- 0 to 39
Good Condition	-40 to 55
Fair Condition	-56 to 70
Poor Condition	-71 to 88

This means that in order to have an Excellent stream condition, there must be at least 12 of the components in Excellent condition, 5 in Good, 3 in Fair, and 2 in Poor condition. By the same scale, a Poor stream must have 12 in Poor, 5 in Fair, 3 in Good, & 2 in Excellent.

Appendix L
Selection and Management of the Interdisciplinary (ID) Team

Presented at Earth Science Symposium II, February 1979
by Darwin L. Richards, District Silviculturist
Hat Creek Ranger District, Lassen National Forest

I. HOW YOU GET INVOLVED IN THE ID PROCESS

A. First Contact - Your receipt of a request for input on a Position Statement will probably be your first major contact on a Timber Sale project. The letter of request for your input from the District Ranger (Letter of Intent) should be explicit on what to provide.

Your job is to:

1. Document sources of information that will help in planning the project, and
2. Provide data to identify the issues, concerns, and opportunities that you feel need to be dealt with in the project planning for the area.

B. Use of Your Input - This input will be used in the Position Statement to determine what disciplines are needed on the ID Team for the project and what areas should be concentrated on.

II. SELECTION OF ID TEAM MEMBERS

A. 5-Year Sale Program Conference - Although the process may vary by forest, it is my experience on the Klamath and Lassen that once each year, Line Representatives, Staff and specialists meet together to (1) review the new Position Statements, (2) make a GO or NO-GO decision for the project to be added to the 5-Year Plan, and (3) select the Core ID Team members and identify additional sensitive areas where special skills are needed but not on a "full time" basis.

The number of core team members usually ranges from 3 to 6 depending on sale complexity. The larger the team, however, the more difficult scheduling becomes.

This Team and the Team leader are approved by line and at that time the team disciplines become committed.

B. Team Leader Characteristics - The Team leader should be a good facilitator, manager, and driving force to get the job done.

Opportunities to use other than Prep or Planning Foresters for this job should be pursued. Consider S.O. or District specialists for use as Team leader. It provides good experience in having to deal with other specialist work and due dates.

C. Importance of Your Input to the P.S. - The ID Team should be tailored to meet the issues, concerns, and opportunities identified in the P.S. Therefore, your input at that stage is essential.

Every discipline should not be routinely assigned to every EA. From your standpoint of time and quality of input, do not try to get involved in every project unless it involves a critical issue in your area of expertise.

D. The Team is Now Selected.

III. MANAGEMENT OF THE ID TEAM

A. Role of Team Leader - The Team leader has a key role to properly organize, schedule, and manage activities of the Team. The emphasis is on coordination of the Team, not domination.

B. Summary of ID Process - The actual ID process in developing a Timber Sale Environmental Assessment (EA) varies from sale to sale. There should be an initial meeting to:

1. Finalize project area objectives.
2. Identify any other critical issues, concerns, or opportunities.
3. Establish evaluation criteria.

These must be approved by Line.

Next comes independent or team data gathering responsive to issues, etc., and evaluation criteria followed by an interdisciplinary meeting to develop alternatives. Alternatives are then assessed.

It is at this point where the ID process often comes unglued. Many specialist reports I have dealt with end up making recommendations for or against an alternative. This puts the decision maker in the position of accepting or rejecting your work.

Your job as professionals in your various disciplines is to come up with the effects of implementing each alternative within the framework of the evaluation criteria.

IV. ID TEAM SCHEDULING

A. How Done - Scheduling should be done on a Fiscal Year Basis at the 5-Year Plan Conference. More definite scheduling would be done at the initial ID Team meeting.

B. Priority - ID Team work should be viewed as top priority. The team cannot do its job and much time is wasted when team members do not attend scheduled get-togethers or are unprepared.

C. Line Involvement - Team scheduling should involve the Line Officer as much as possible to help maintain accountability with the objective of minimizing changes in the EA development schedule.

D. Program Budgeting - A real key to working yourselves out of the seemingly endless crunch for time and dollars is to become actively involved in the Program Development and Budgeting process. This is currently being done for FY's 1981 through 1983. By identifying anticipated specialist support time and dollar needs early, you can do your part in helping the Timber Sale Planning Process operate more smoothly.

V. SUMMARY - KEY POINTS

A. Respond to the "Letters of Intent" on new timber sale projects.

B. Provide the Effects of Implementing Project Alternatives in your input to the ID Team. Avoid "yes/no" recommendations.